A STUDY OF IRRIGATED FARM ORGANIZATION ADJUSTMENTS IN SOUTHWEST KANSAS

763

by

DALE JOHN BLOMQUIST

B. S., Iowa State University, 1965

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Economics

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1967

Approved by:

Melvin D. Skold

Major Professor

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The author gratefully acknowledges the assistance and guidance of his major professor Dr. Melvin Skold, who provided encouragement and gave valuable suggestions and helpful advice not only in the preparation of this manuscript but all through his graduate program at Kansas State University.

The author is also grateful to Mr. Charles W. Nauheim for furnishing and assisting in setting up the emperical data and also for his valuable suggestions. Also appreciation must be extended to my fellow graduate student, Ross Olson, for helpful comments, and assisting in the computer work done in this study.

CHAPTER I

INTRODUCTION

This study was concerned with finding optimum farm organizations for irrigated farms in a fifteen county[1] area in southwestern Kansas shown in figure 1. The search for these optimum farm organizations was prompted by the recent announcement by the U. S. Department of Agriculture of two 15 per cent increases in the wheat allotment for the 1967 wheat crop. The analysis also explored the competitive position of hogs on irrigated farms in this area. Since irrigation helps to insure a more stable supply of feed grains, hogs are an enterprise worthy of consideration in the organization of farms with irrigation.

Irrigation in southwestern Kansas has been a great benefit to the economy of this area. This is an area of Kansas subject to much uncertainty of crop yields and agricultural incomes. While the amount of resources used tends to be relatively stable, the yields are known to vary greatly from year to year mostly due to climatic conditions. Castle stated:

> Agricultural income has been notoriously unstable. This has been due not only to the variable price of agricultural products and the costs of the factors used in their production but also to the irregularity of agricultural yields. This is particularly true

---

[1]The counties included in this area are Morton, Stevens, Seward, Meade, Stanton, Grant, Haskell, Gray, Hamilton, Kearny, Finney, Greeley, Wichita, Scott, and Lane.

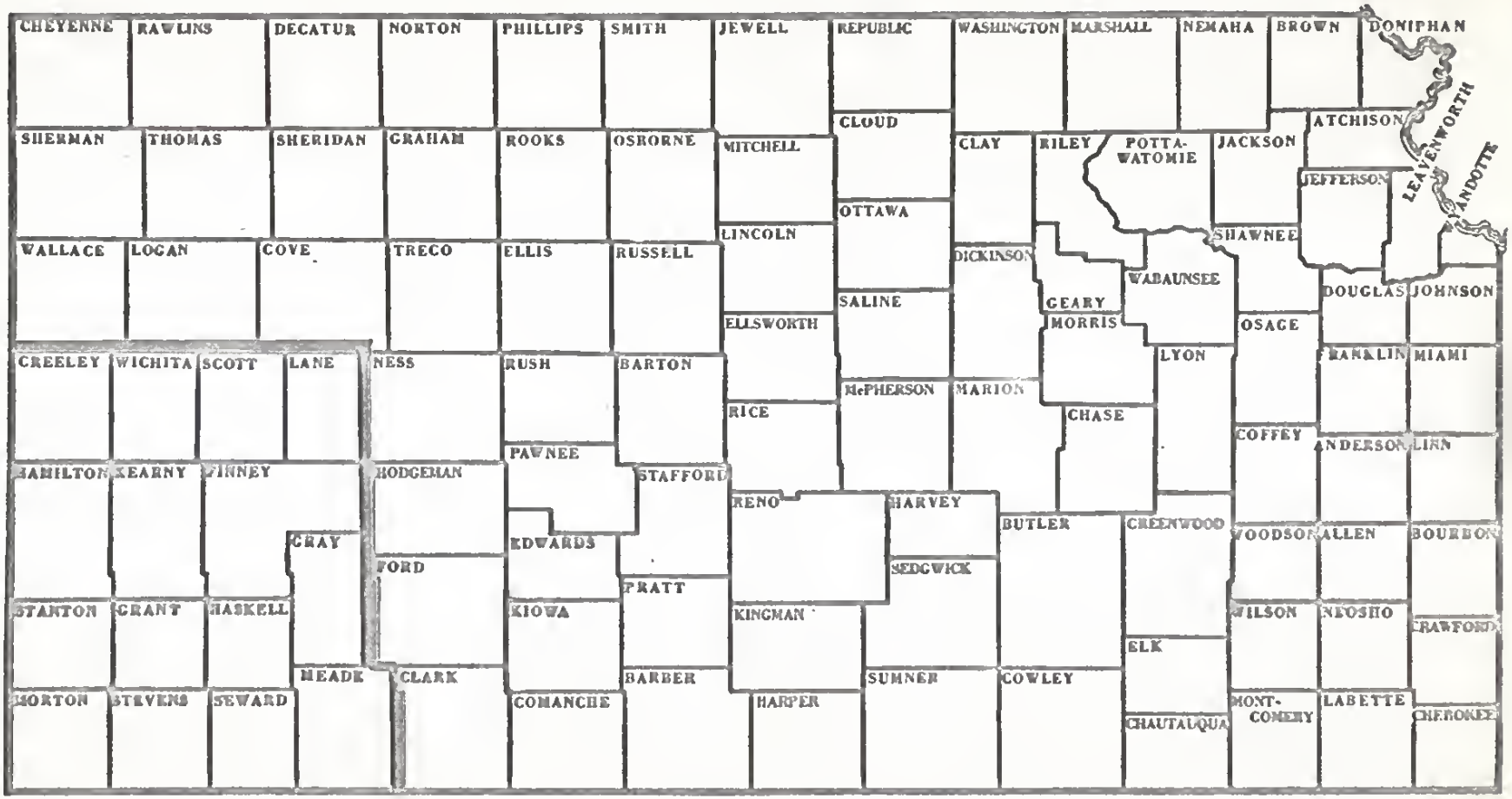

Figure 1. Southwest Area of Study

of western Kansas where the highly variable weather conditions cause yields to fluctuate more than they do in more humid areas.[2]

Castle also found that farm income was more stable with wheat as a primary crop but combined with other crops and livestock enterprises, since the variability of certain crop and livestock enterprises is lower than the variability of wheat alone. This study included both crop and livestock enterprises so as to make it as realistic and comprehensive as possible.

With the extensive development of irrigation in this area over the last 20 years, much more stability has resulted in farm production and farm income. According to the Kansas Farm Management Association records, the incomes of association members in the southwestern area of Kansas have been increasing over the last several years so that in 1965 members in this area had the highest net income for any association in the state. By looking at tables 1 and 2 we can see that the increase in farm income in the southwest area has taken place in the shadow of the development of irrigation.

As can be seen from table 1 the amount of land under irrigation since 1945 has increased substantially each year, although irrigation development progressed rather slowly previous to this time. Also the number of farms having irrigated land has increased considerably as well as the percentage of farms having irrigated land. In addition, from 1945 to 1964 the amount of irrigated land on each farm has increased considerably. In 1945 evidently there was no need in the

---

[2]Emery N. Castle, Adapting Western Kansas Farms to Uncertain Prices and Yields (Ag. Exp. Sta. Tech. Bull. 75, Kansas State University, Feb., 1954), p. 5.

TABLE 1

Development of Irrigation in Southwestern Kansas
from 1945-1964

	1945	1950	1954	1959	1964[a]
Number of farms with irrigation	481	667	1,109	1,613	1,805
Per cent of farms with irrigation	8.14	23	27.31	36.40	N. A.
Number of acres irrigated on farms:					
1-9	N. A.[b]	23	N. A.[c]	21	N. A.
10-19	"	17	"	23	"
20-29	"	27	"	31	"
30-49	"	55	"	49	"
50-99	"	145	"	149	"
100-199	"	213	"	382	"
200 or more	"	189	"	656	"
1000 or more[d]	"	N. A.	"	58	"
Average size of irrigated farms	"	1,168.54	1,349.23	1,429.25	"
Amount of land under irrigation	103,568	116,755	232,395	522,007	685,007
Crop land irrigated	N. A.	104,853	219,613	462,789	554,921
Pasture land irrigated	N. A.	3,579	13,002	59,218	130,586

[a]Data taken from 1964 Preliminary Census Report.

[b]N. A. means data not available.

[c]Census data in 1954 changed on this data so that it is not consistent with the other columns.

[d]This category was not used before 1959. So if there were any irrigated farms this large they are included under 200 acres.

TABLE 2

Net Farm Income by Farm Management Association of the State of Kansas - 1955-1965[a]

Year	Association Area					
	N. C.	S. C.	S. W.[b]	N. E.	N. W.[b]	S. E.
1955	$ 957	$ 133	$ 1,673	$ 711	$ 2,208	$ 1,263
1956	2,721	3,929	1,071	3,213	820	2,867
1957	4,390	3,889	5,277	5,524	6,829	3,940
1958	7,726	7,835	9,640	5,837	10,270	5,830
1959	3,207	4,416	3,734	3,107	6,171	4,900
1960	5,719	6,223	11,746	5,213	12,661	5,685
1961	6,013	8,350	11,983	5,309	7,953	4,647
1962	7,486	7,428	11,816	5,951	12,197	5,729
1963	5,523	5,526	3,895	4,671	4,661	3,993
1964	5,249	6,127	5,457	4,758	2,319	5,319
1965	8,795	10,791	13,720	9,147	8,623	9,900

[a]Data obtained from 1965 Farm Management Association Annual Report.

[b]Both of these economic areas contain some of the counties that were grouped together for this study.

Census figures for farms having more than 1,000 acres of irrigated land, but in 1959 there were 58 farms having more than 1,000 acres of irrigated land. This was probably due not only to the development of irrigation that had taken place in this area during this period of time, but also was partly due to the increase in the size of farms having irrigated land as can be seen from table 1.

At the present time much of the land that is being leveled for irrigation is marginal land. Marginal land is land that requires a large cost to level and therefore it is on the margin as to whether it pays the farmer to develop it for irrigation. Some agricultural engineers feel that the amount of land under irrigation has about reached its limit. Because of the large cost and also the lack of adequate water supplies, some farmers are now getting around the expensive leveling costs by using sprinkler systems.

Erhart stated:

> Irrigation is a sound and entirely feasible system of farming in southwestern Kansas. Under irrigation, the hazard of drought is limited, but fixed costs of production are increased. The cost of failure is high. Negligent and careless planning can be disastrous. Insects, disease or hail can wipe out an irrigated crop as quickly and completely as dry land crops. It is extremely important to strive for maximizing sustained economic returns. All of the factors that affect crop returns should be as near optimum as possible. This includes not only water, but fertility of the land, type and variety of crop, planting dates, rate of seeding, rotations, cultural practices, control of insects and diseases, harvesting methods, and crop utilization or marketing.[3]

All these factors, it is hoped, have been incorporated in this model and are reflected in the cost of production and input-output figures.

---

[3] Andrew B. Erhart, Walter R. Meyer, and Ben L. Grover, Irrigation in Western Kansas, (Kansas Ag. Exp. Sta. Cir. 324, Kansas State University, May, 1958), p. 5.

These figures were reached through consultation with agronomists, animal scientists and others to obtain their opinions as to what the level of application of the above mentioned factors would be under conditions of good management.

Constant change in agriculture calls for many adjustments to be made in the farm organization to maintain this optimal condition as near as is feasible. This is especially true on irrigated farms, so as to obtain the maximum returns because of the greater amount of investment required. During the last several yeare there has been much talk in agricultural circles of the "cost-price squeeze." Perhaps there is more of a need on the part of farmers for re-examination of typical farm organizations in the light of major technological developments such as irrigation. Maybe this would help to alleviate part of the pressure the "cost-price squeeze" has caueed.

A major change in farm programs also gives cause to re-examine farm organizations and resource commitments. In the wheat area of southwestern Kansas a change in the wheat policy could give rise to the need for making some adjustments in the farm business organization. In view of the most recent change in the wheat program, probably the first or major decision to be made is whether farmers can shift some of their resources from their present use to increase their wheat production and thereby improve upon their economic objectives. As a result, this has brought or will bring the farmere of this area to the place of deciding how much, if any, of this new increase in wheat allotment they will plant and how they will make adjustments in other areas of their farm organization.

But their economic objectives may not be just profit maximizing objectives. Perhaps some farmers like to grow wheat and therefore will take advantage of the whole allotment increase by planting all the increased allotment to wheat. Or another farmer, or group of farmers, may feel that by taking advantage of this increase in wheat allotment may cause wheat surpluses to build-up again. Therefore, they will maintain present production. They would then be concerned in maintaining the present prices of wheat over a period of time, thereby stabilizing their incomes in terms of prices received.

Description of the Area

Much of southwestern Kansas concerned with in this study has been covered by deposits transported by wind. These deposits are of either sand size or silt size. There are also some water-laid deposits. "Older alluvial deposits associated with the Rocky Mountain uplift are quite extensive in the western part of Kansas. Below the surfaces, these materials serve as an excellent reservoir for water storage and are the source for most of the ground water used for irrigation in that area."[4]

The main soil types found in southwest Kansas are the Richfield Colby and Dalhart Mansker. The Richfield-Colby is a fine textured soil found mostly in the northern counties of this area, while the Dalhart — Mansker is more of a sandy type soil which is more subject to wind erosion and is found mostly in the southern part of the area. Both

---

[4]O. W. Bidwell, Major Soils of Kansas (Ag. Exp. Sta. Circular 336, Kansas State University, July, 1956), p. 4.

respond quite favorably to irrigation. They are well adapted to native grass.

Long term annual precipitation averages range from 16 inches along the western border of the area to 22 inches along the eastern border. Grain sorghum and wheat are the principal crops grown, although some corn is grown both for grain and silage, but it is grown extensively on irrigated ground. There is also some forage sorghum, alfalfa and silage grown. The average length of the growing season is from 160 to 185 days. Most of the irrigation water comes from underground water supplies, although there is some ditch water used in part of this area.

The Problem and Objectives

This study was primarily concerned with analyzing the impact of the two 15 per cent increaees in the wheat allotment, which was announced by the U. S. Department of Agriculture in the summer of 1966, on farm organizations if adjustments were directed towards maximizing net income. Secondly, this study concerned itself with the problem of how the hog enterpriee would fit into the farm organization on irrigated farms in southwest Kansae. This study wae confined to farms with irrigation in the fifteen county area of southweetern Kansas.

The specific objectives of this study were: (1) to determine what factors of the farm businese farmers should consider in contemplating the alternatives which are open to them in using this new increase in their wheat allotment. (2) To ehow and analyze the possible changes that should take place in the wheat farmers' present farm organization, if any, so as to maximize the net profit of their farm businees.

(3) To determine if the hog enterprise could profitably be incorporated on farms with irrigated land in this area, and how the enterprise would fit into and affect the farm enterprise organization. (4) To appraise the effect of the hog enterprise on the farm business.

Situations to be Studied

A source of uncertainty relating to the recent change in the wheat program is what is the most likely price that will prevail for the 1967 wheat crop. Consequently, three price situations were considered which include alternative bases of formulating price expectations. The prices of wheat, feed grains, beef cattle, and hogs were considered at alternative levels; otherwise all prices, costs and resource levels were assumed given and constant. Lin states:

> There are five reasons for making price or revenue changes: (1) to discover how optimum farm plans will be affected as relative prices vary; (2) to develop a series of optimum programs for different price situations even though the exact level of future prices is not known, (3) to examine the price range over which a certain optimum plan will remain stable; (4) to get an analytical insight of the effects of price changes on the structure or the combination of farm enterprises; and (5) to provide information which may be useful to policy makers interested in possible production adjustments that would seem desirable as a result of changes in relative prices.[5]

This study assumed that the price levels on which the farmer bases his production decisions will be the current market prices, the futures market prices or on the government support prices.[6]

---

[5] G. Lin, "Organization of Farms in Western Kansas: A Statistical and Programming Approach," Unpublished Ph.D. dissertation. Department of Economics and Sociology, Kansas State University, 1964.

[6] There is a short discussion presented in Appendix B on how each of these price levels were determined.

In making production decisions it was assumed for this study that farmers use one of these three price levels in formulating price expectations. They may not calculate the price expectation quantitatively but whatever method they use it was assumed that they will in some manner base their expectations on known price figures that are available. Certainly the current market prices, futures market prices and support prices are three important price levels that are known and easily obtained.

When farmers decide on what and how much of each of several products they are going to produce, they more or less decide on the basis of what prices they expect to receive when they are ready to sell the product. The three price situations used in this study seem likely possibilities for farmers to base their production decisions on. There may be others but only three were used in this paper.

Each of the price situations was programmed with and without hogs.

Price Situation I. This price situation assumed that current prices were used in determining farm production. In this situation no hogs were allowed to come into the program. It assumed prices of $1.10/bu for feed grain, $1.76/bu for wheat, and $24.30/cwt for beef cattle.

Price Situation II. This price situation is the same as Situation I except that hogs were allowed to come into the program at a price of $24.50/cwt.

Price Situation III. Under this price situation futures prices were assumed. Again no hogs were allowed to come into the program. The prices assumed were $1.70/bu for wheat, $1.20/bu for feed grains and

$28.38/cwt for beef cattle.

Price Situation IV. Under this price situation the same assumptions were made as under Situation III except that hogs were allowed to come into the program at a price level of $20.83/cwt.

Price Situation V. All prices in Situation V were assumed to be at the current level for each enterprise having variable prices except for wheat. The wheat price was assumed to be at the support price level of $1.17/bu.[7] Situation V was programmed without hogs.

Price Situation VI. The same assumptions were made for this price situation as Situation V. But hogs were allowed to come into the price program in this price situation at a price of $24.50/cwt.

---

[7]This price of $1.17/bu for wheat is the average support price received in 1966 in the 15 county area included in this study.

CHAPTER II

LINEAR PROGRAMMING AS A TOOL OF ANALYSIS

As a Tool of Farm Planning

Each particular farm, irrigated as well as dry land, has a certain amount of land, capital and labor available. Each farm operator is faced with various possible combinations of these resources. Their assumed objective in this study was to obtain maximum net profit.

As a science of choice between alternatives, production economics relies strongly on maximizing or minimizing conditions. Economic analysis facilitates the choice of production patterns and resource use so that the objectives of the farmers can be achieved. But with changes, such as this recent change in the wheat allotment or the rapid development of irrigation, it is a difficult task to collect and analyze this information even for the agricultural economist, much less the farmer. Linear Programming is a significant advance that has been made in the technique for doing this job more efficiently. It was developed for the purpose of determining how to use limited amounts of resources to best advantage.

Definition and Assumptions

Perhaps a good definition of Linear Programming from an economist's point of view is the following definition. "It is a technique for allocating a group of limited resources among a number of competitive demands

where all decisions are interlocking because they are made under a common set of fixed limits."[1]

One of the main reasons that linear programming was used was that it is an efficient method of analysis for a problem the size and scope of the one in this study. Although by the various assumptions of linear programming, it is somewhat limited in a study such as this one, it was not felt that these limitations were critical to the analysis. It is a productive tool, even with these limitations. Below are listed the main assumptions of linear programming as they are given in Heady and Chandler's book,[2] as well as some limitations they cause in this study.

1. Addibility and Linearity. That is, the amount of resources used by the several enterprises must equal the sum of the resources used by each individual enterprise. Also it is assumed that the amount of resources used in one enterprise is directly proportional to the output from that enterprise, i.e., output is a linear function of input. As result we have no diminishing returns assumed, but we assumed constant returns. Theoretically and practically there is a point of diminishing returns in irrigation farming, but even though this is true for irrigation farming in general, it was felt that the size range of farms that this study considers, along with the resources available in each farm situation, no significant economies or diseconomies of scale would

---

[1] Robert O. Fergonson, and Lareun F. Sargent, Linear Programming: Fundamentals and Applications, (New York: McGraw-Hill Book Company, Inc., 1958), p. 5.

[2] Earl O. Heady and Wilfred Candler, Linear Programming Methods, (Ames, Iowa: The Iowa State College Press, 1958), p. 1-52.

be present. Therefore, this assumption of linearity can be assumed without much being lost in the way of finding solutions for each farm situation.

2. Divisibility. It is assumed that factors can be used and commodities can be produced in quantities which are fractional units. This assumption is not very limitational because usually output can be rounded off to the nearest whole figure without seriously affecting program results. Also many inputs can be applied in very small units.

3. Finiteness. Here it is assumed that there is a limit to the number of alternative activities and resource restrictions that need to be considered. This assumption is necessary and reasonable, because if the farmer were to consider every possible activity there would be no limit to the number he could evaluate. In this study 115 activities were considered of which 26 were crop activities, 18 were livestock activities and the rest fall into selling activities, transfer activities and things of this nature.

4. Singled Valued Expectations. In linear programming we assume away much of the uncertainty. It is assumed that resource supplies, input-output data coefficients and prices are known with certainty. This assumption is unrealistic in many farm situations. However, other research techniques, such as budgeting, employ the same assumptions.

But even with uncertainty, a producer must still make production decisions. In the southwest area it is historically apparent that wheat and grain sorghum must be viewed by farmers as being the most profitable crops in the southwest area, otherwise it is very hard to explain their existence.

In agriculture farmers are faced with many uncertainties in making the right decisions. With the development of irrigation the uncertainty of crop failure as result of drought has almost disappeared for crops that are irrigated. But still farmers may have their crops destroyed by disease and insects, although new insecticides and herbicides have greatly reduced this uncertainty. Of course there is always the possibility of hail or some other unusual weather phenomenon, but this is reduced by taking out insurance to guard against such catastrophies. As a result, one of the greatest uncertainties is that of prices that will be received for the crop farmers plant now but will not be harvested until several months later. But even this perhaps is no longer as great with the advent of government support prices and futures markets.

In this study the three possible price levels, which are the price expectations, it was assumed, on which farmers will base their production decisions, were programmed in connection with making management decisions concerning the increase in the wheat allotment, along with the possibility of increased hog production in the southwest area. The price expectations can be incorporated in a linear programming model quite easily. These other uncertainties, such as weather and insect damage, cannot be incorporated in the model quite as easily. Thus, concerning crop production uncertainty, we assumed a most likely yield under normal weather and good management for the crop production period. Some factors of uncertainty for crop production were put in the model such as wheat and grain sorghum abandonment coefficients.

When comparing linear programming with other methods of analysis

such as budgeting, marginal analysis and regression analysis, the method of linear programming seems to be more realistic and useful when considering undertaking a study of this nature.

Linear programming is much more efficient than budgeting in respect to the ease of calculation. Whereas linear programming problems can be run through a computer in a matter of minutes or hours, it takes much longer to do the process by the budgeting method. But both use basically the same assumptions.

> In comparison to marginal analysis, which is that of the traditional smooth curve, instead of seeking optimal combinations of inputs or outputs, we seek the optimal combinations of levels of activities. Thus, linear programming analysis provides more information than the marginal approach. It not only defines a goal in terms of optimal quantities of input, but it also gives direction for achieving the goal in terms of various activities available to the firm.[3]

A regression analysis would show how farmers actually have reacted while linear programming is mainly a procedure for indicating or showing a course of action which ought to be taken by an individual when the ends and objectives take a particular form and the conditions and restraints surrounding the action are of a particular form. In this study the objective is one of maximizing profit. The resource restraints used are an average of the available resources on each of two defined types of irrigated farms in southwest Kansas. The results should be interpreted in this light, not as exact answers, but as a possible course of action in making adjustments in response to the price and production changes considered.

---

[3]Robert Dorfman, Paul A. Samuelson, and Robert M. Solow, Linear Programming and Economic Analysis, (The Rand Series; New York: McGraw-Hill Book Company, Inc., 1951), p. 140-141.

Farmers may follow some other course of action because they have objectives other than profit maximization. Also they may have different kinds and amounts of resources from those upon which the program plan is based. This linear programming model does not attempt to explain why farmers provide for different patterns of resource use. Thus, because linear programming results do not try to explain structural relationships or human behavior, we can enhance the breadth of the problem which can be analyzed, although from time to time in the analysis part of this paper digression will be made concerning human behavior and structural relationships.

CHAPTER III

THE MODEL: DATA COLLECTION AND ASSUMPTIONS

Main Assumptions

The assumed goal for the individual farmer in this study was that of maximizing profit, or what is essentially the same thing, as that of maximizing net returns to the fixed resources that they have to work with. As has been stated before, we were programming with no attempt to satisfy other goals the farmer may have.

It was assumed that the final solution obtained for each farm situation at the various price levels are "intermediate"-run[1] solutions. The optimal solutions assumed adjustments can be made in the farm situation so that the solution can be carried out. It was realized that immediate adjustment can not be made, because, in general, reallocation of farm resources can not take place so rapidly. These solutions should be something that a farmer would consider as adjustment guidelines. In this analysis we will try to indicate in what way farmers should adjust their farm business to take account of the increase in wheat allotment or the possibility of the hog enterprise so as to maximize profits on

---

[1]It seems that the final solutions obtained do not really conform to the traditional long-run or short-run situations. Land and labor are both fixed quantities, hence this is not really a long-run situation. But machinery and equipment cost (allocated to enterprises) were included so we are thinking of something more than the short-run situation. The term "intermediate"-run seems to describe the situation used in this study.

their farm. If farmers had a better knowledge of which way they should go in making management decisions on their farm, this adjustment could be made faster and more wisely.

This study assumed an above average level of management. Justification was based on the belief that the average farm manager should be given something to strive for. This is how progress comes about. Also it was believed that this level of farm manager will make the necessary adjustments on his farm and will be able to see this adjustment to completion. Although a number of farmers in the area of study rent land, the study has assumed that the farm situations are set up on an owner-operator basis. This tenure assumption seemed justified on account of the many leasing arrangements used by farmers. To take account of all of these arrangements would take additional studies to investigate alternative tenure conditions.

Production practices, that are reflected in the input-output coefficients, were developed to reflect 1970 production methods. The adjustment to the 1970 situation has been made for both inputs and outputs. One reason this was done was because the present study is a phase of a larger regional projection study made in connection with this area of Kansas. Perhaps the coefficients may seem optimistic in some senses. As result of this adjustment, it should enhance this study's usefulness not only now but for several years to come. Also this assumption goes along somewhat with our previous assumption of "intermediate"-range plan adjustments resulting from this study.

Livestock feeding operations were restricted in that only one-half of the feed grain[2] produced on the farm could be used for feeding purposes. No feed grains could be purchased and all of the roughage used by livestock must be produced on the farm. Also, enterprises were restricted to the present amount of labor. Grain sorghum fallow was limited to one-tenth of the dry crop land. This assumption was made because of the erosion hazards associated with allowing large amounts of land to be farmed in this manner.

Also one-half of the abandoned wheat ground[3] was allowed to be used for grain sorghum production. No forage sorghum was assumed to be sold because it is usually raised on the farm and fed there in the southwest area of the state, so there is not an organized market for forage sorghum.

It was assumed that the use of irrigation water would be the heaviest during the months of July and August. Therefore, water use constraints were placed only on these two month's water supplies.

Wheat planted in the fall was allowed to be pastured in the fall. This not only provides good and cheap pasture for cattle, but it also tends to improve the wheat crop if proper management practices are exercised.

---

[2] In obtaining the amount of feed grain produced the amounts of grain sorghum produced is adjusted to a corn equivalent basis by multiplying the amount of grain sorghum produced by .95. The .95 indicates the relative feed value of grain sorghum as compared to corn.

[3] Abandoned wheat land is defined in this study as land which was planted in the fall to wheat but for some reason, weather, insects, etc., it is not harvested.

When hogs are allowed to come into the program they are limited to a maximum of 30 sows being farrowed twice a year. The input-output coefficients pertaining to the hog enterprise reflect a 20-sow group and a 10-sow group both farrowed twice a year. This assumption seemed necessary since when hogs were allowed to come in in unlimited amounts the farm organization changed so much that these farms appeared as specialized hog production units.

Sampling

In order to obtain data concerning the resource situations found on the farms in this area, a systematic sample of 310 farms was drawn from the County Assessor's books of the counties involved in this study. The percentage of the farms of the area included in the sample was between five per cent and six per cent.

From the sample a division was made first between the farms with no irrigation and those having some irrigation. The division was made on the basis of differences in resource requirements for irrigated land as compared to dry land. In the first place the irrigated land is farmed much more intensively and thus requires much more capital and labor resources per crop acre. Further, irrigated land has a resource, water, applied to it that the dry land does not have manually applied. Also, as a result of the more intensified farming on irrigated farms, such productive factors such as land, labor and capital must be organized and used in a different way than on dry land farms.

The irrigated farms, which we are concerned with in this study, were further broken down by size of farm. These farms were first broken

down as to the intensity of livestock production. To do this a crop land to pasture land ratio was used. Thus, the lower the ratio the greater the proportion of pasture land on the farm and hence the more livestock, especially cattle, should be raised. The higher the ratio, the smaller was the proportion of the farm land devoted to pasture land and hence less cattle should be raised.

But using the ratio of crop land and pasture land proved to be unsatisfactory because the amount of pasture land did not seem to affect the amount of livestock, especially cattle, being raised very much. This seemed reasonable due to the fact that much of the beef produced in this area is winter grazed on wheat pasture and then either fed out on grain produced on the farm or sold after wintering on roughage and a little grain. As a result the native pasture land would not seem to significantly affect the farm organization. This was indicated by the "shadow" price of pasture land as compared to crop land or irrigated land as will be presented later in the paper. This was more evident on irrigated farms than dry land farms in the programming.

The irrigated farms were divided into two strata, one with farms less than 1,000 total acres and another farm class of greater than 1,000 total acres. More than two divisions of irrigated farms were considered using the ratio of irrigated land to crop land. But this further breakdown did not seem necessary after doing some preliminary programming with just the two divisions. It was found that by using the two divisions that the farms were naturally divided into a one-well farm and a two-well farm. This seemed to be a justified division due to the fact that here again were two different resource situations that

were basically using the same productive practices only one was doing so on a larger basis. It seemed a reasonable hypothesis that land would be the limiting resource with one-well farms and that labor would be the limiting resource on the two-well farms. Then this would call for different organization and use of resources on the two farm situations. This proved to be a correct assumption as will be shown later in the analysis part of this paper.

Resources Available (Land, Labor, Capital and Livestock)

Resource levels derived from the sample for each farm of the two farm situations are shown in table 3. Estimates in table 3 represent an average amount of resources available for each farm situation in the sample included in each class. Also the current organization of the two farm classes is shown in table 4.

Livestock Facilities. The number of hogs raised, as shown in table 4, was practically nil. Although there was some variation in the number of hogs raised, the numbers were quite small. The majority of the farms in the sample taken had no hogs at all.

Although the figures for beef indicate quite a number being raised, yet there was a great deal of variation here so that actually the figures given are misleading in some respects. The number of cattle on farms in the sample ranged from zero to several hundred head. Many farms had no livestock.

Because of the scope of this study the poultry and sheep enterprises were completely ignored. As can be seen from table 4, their number, like hogs, were almost nil.

TABLE 3

Resource Constraints Used For a Large Irrigated Farm and For a Small Irrigated Farm

Resource	Large farm	Small farm
Land (acres)		
Crop	1,719	513
Pasture	385	54
Irrigated	574	329
Government program	1,219	364
Wheat allotment (new)	723	216
Wheat allotment (old)	567	169
Feed grain base	495	147
Limit grain sorghum on fallow	114.5	18.4
Water (acre-inch)		
July	2,520	1,260
August	2,520	1,260
Labor hours (operator)		
January	202.0	202.0
February	199.2	199.2
March	206.5	206.5
April	212.4	212.4
May	219.0	219.0
June	228.0	228.0
July	229.0	229.0
August	232.5	232.5
September	227.0	227.0
October	221.4	221.4

TABLE 3 (continued)

Resource	Large farm	Small farm
Labor hours (operator)		
November	213.4	213.4
December	202.8	202.8
Labor hours (hired)		
January	404.0	202.0
February	398.4	199.2
March	413.0	266.5
April	424.8	212.4
May	438.0	219.0
June	456.0	228.0
July	458.0	229.0
August	464.0	232.5
September	454.1	227.0
October	441.8	221.4
November	426.7	213.4
December	405.6	202.8

TABLE 4

Current Organization of the Two Irrigated Farm Classes

Enterprises	Large farm[a]	Small farm[a]
Total Land (acres)	2,104	567
Crop land planted (acres)		
Wheat	583	172
Corn	36	32
Grain sorghum	298	111
Sudan and Millet	10	6
Alfalfa	13	10
Native pasture	385	54
Fallow land	636	154
Irrigated land	516	286
Irrigable land	574	329
Livestock (head)		
Hogs and pigs	2	1
Sows farrowed	0.1	0.1
All Cattle	141	68
Milk cows	0.3	0.6
Grain fed cattle	24	6
Grass fed cattle	100	42
Chickens	7	7

[a]These figures are average figures obtained from the sample drawn.

In the programming, as has been mentioned before, the number of hogs has been limited to 30 sows farrowed twice a year. Cattle were not limited specifically by number in the model. They were allowed to come into the final solution as much as they were able to in light of all the constraints. Actually the amount of pasture land (native and wheat) limits cattle production more than anything else when no hogs were in the solution. When hogs were in the solution, labor became the resource that limited beef cattle production.

Land. The land resource falls into three categories, dry crop land, irrigated crop land and native pasture land. The amounts of these three types of land for each farm situation are also shown in table 3 as well as in table 4, which shows the present organization of these two farm situations.

There is the possibility of adding land to the farm classes but this was beyond the scope of this study, and with our assumption of an "intermediate"-run situation land is assumed to be a fixed amount.

The wheat allotment figures shown have been adjusted to reflect the increase in wheat allotment that has been allowed by the U. S. Department of Agriculture. The government program restraint reflects the opportunity that the wheat farmer has to substitute feed grain base for wheat allotment or vice versa. This figure was obtained by figuring the average per cent of crop land used for the feed grains and wheat allotment for the years of 1963 and 1964. Then by combining these two percentage figures and multiplying by the amount of crop land available in each farm situation, a figure was obtained which indicated the total amount of crop land available for wheat and feed grains. In the model

wheat could not be substituted on feed grain allotment because of the wheat allotment constraint, but feed grains could be substituted on wheat allotment acres because there was no feed grain allotment restraint except as it was reflected in the government program allotment constraint.

Labor. Labor was divided into two categories: operator labor and hired labor. Within each category there were twelve labor periods defined, each month representing a separate period. At first it was thought that perhaps fewer labor periods could be used and therefore allow the transfer of labor between months for operations that were not critical if they were put off for awhile. But after looking at it more closely, it was found, that especially on irrigated farms, the large labor consuming activity was the irrigation process and that this was quite a critical operation, i.e., it had to be done at the proper time and could not easily be put off when the water was needed. So it was decided to stick with the monthly labor periods. The labor restraint figures are shown in table 3.

The large irrigated farms were allowed to have two full-time hired men plus the operator's labor. On the small irrigated farm situation, only one full-time hired man was allowed in addition to that of the operator. It was assumed that the operator's labor is available without charge, hence it was assumed fixed. But labor used in addition to the operator's labor was hired at a rate of $1.31/hr., i.e., hired labor must return $1.31/hr. before it is used. The labor used figures were quite consistent with what was reported in the 1965 Farm Management Association publication for this area. The labor figures assumed 26 days

worked per month and also assumed a ten-hour day. Adjustments were made to allow for the probability of a wet day when no field work could be done.[4]

Capital. There were two categories of capital: direct costs and operating capital.[5] There was no restraint or limit placed on either category of capital, but in the model they were allowed to accumulate and go as high as needed for an optimal solution. Before capital would be employed, however, it must yield at least a seven per cent return in the enterprise on which it was used. The operating capital used was charged with the seven per cent interest rate. From Appendix C it can be seen that cash costs and operating capital figures overlap.

Enterprises Considered

Some of the input-output data used in this model for the various activities discussed in this section are shown in Appendix A. The types of activities and enterprises considered are discussed below.

Crop Activities. Since both irrigated and dry land crop land were available, crops could be grown under both systems. Provision was made in the model to allow for irrigated land that was not used, to be farmed under dry land conditions. On the dry land part of the crop land, the farmer was given the choice of producing grain sorghum, wheat, forage sorghum, sorghum silage, or barley. Neither corn or alfalfa were

---

[4] L. Dean Bark, Chances for Precipitation in Kansas, (Ag. Exp. Sta. Tech. Bull. 461, Kansas State University of Agriculture and Applied Science, May, 1963), p. 25.

[5] How capital divisions are calculated and how they are defined is explained in Appendix C.

included as dry land crops. The corn was not included because the input-output data indicated that dry land grain sorghums would always dominate it. The alfalfa activity was not considered as dry land because of the fact that very little of it is grown. Because the acreage was so small, it was felt it could be left out of the model completely without seriously affecting the optimum solutions.

Wheat and grain sorghum were the most important of the possible crops the farmer was allowed to raise. There were eight dry land wheat and grain sorghum cropping activities for the two crops. The following is a short description of each of the wheat and grain sorghum dry land crop activities. There was a wheat on fallow activity where the land was summer fallowed and then planted to wheat in the fall. The wheat-wheat-fallow activity was a three year rotation. It was the same as the wheat-fallow activity except that two years of wheat were grown on the land following the summer fallow period. The wheat-grain sorghum-fallow activity was basically the same as the wheat-wheat-fallow activity except that the second year after fallow the land was planted to grain sorghum. In the wheat continuous crop activity, wheat was planted on the land every year with no fallow.

In the grain sorghum fallow activity summer fallow was followed by a year of grain sorghum, i.e., there was always a period of fallow before the grain sorghum was planted. The grain sorghum continuous crop activity has grain sorghum planted in the land after the cropping period. There was no period of fallow in between. The grain sorghum on abandoned wheat crop activity was grain sorghum that was planted on wheat ground where wheat was planted before but for some reason the wheat

will not produce anything so it is planted to grain sorghum in the spring.

Irrigated crops included were: grain sorghum, wheat, alfalfa, corn, sorghum silage and corn silage. Both pre-irrigated and full-irrigated grain sorghum activities were included as well as pre-irrigated and full-irrigated wheat activities.

There were four irrigation crop activities for wheat and grain sorghum. The pre-irrigated wheat activity was essentially like the wheat continuous activity except that the ground was irrigated just before the wheat was planted in the fall. The full-irrigated wheat activity was the same also except that it was watered one more time than the pre-irrigated wheat. It was also watered in the early part of May in addition to the fall watering.

The grain sorghum pre-irrigated activity was essentially the grain sorghum continuous crop activity but with one irrigation made before planting. This irrigation was usually done in the late fall or early winter. The full-irrigated grain sorghum activity allowed for two irrigations besides the one made for the pre-irrigated activity. These two extra irrigations were made after the crop was planted, once during the boot stage and once during the dough stage.

Beef Activities. Several types of beef feeding and cow-calf operations were considered. The beef feeding methods vary as to the type of the animal fed and the method of feeding the animal. There were two general types of calf feeding operations with four different methods of feeding under each. These two types were wintering calves and wintering and grazing calves. Calves which were wintered and grazed were kept

a full year (October 1 to October 1), while calves that were just wintered were kept from October 1 to April 1. These two types could either be fed on (1) wheat pasture and alfalfa, (2) native pasture and alfalfa, (3) wheat pasture and silage, or (4) native pasture and silage.

A beef cow enterprise was also included and four beef cow herd feeding methods were considered. These four are the same methods mentioned above for the calf operations.

Also three steer feeding operations were considered. It was possible to (1) feed steers on grain and protein supplement alone, with forage sorghum the first 30 days, or (2) to allow them to be on wheat pasture for 30 days and then be placed on grain silage and protein supplement for the rest of the feeding period or (3) to feed them on grain and protein supplement the whole feeding period except for 30 days of wheat pasture, but to feed alfalfa hay and silage along with the grain and protein supplement.

The model permitted the purchase of feeder calves or feeder steers. Calves could be produced through the beef cow herd enterprise as well. Calves that were wintered and grazed could be fed out as fat steers if such was deemed profitable. Feeder steere could be purchased October 1st at 680 pounds and sold at 1,075 pounds 180 days later. It was assumed that calves would be bought at 430 pounds. The winter and grazed calves would be purchased on October 1st and sold on September 1st at 731 pounds, while the wintered calves were sold at the end of 180 days at 637 pounds.

Hog Activities. Two hog enterprises were included in this study. They were both basically the same type of set-up except that one was based on a 20 sow unit and the other on a 10 sow unit. Under each

system two farrowings were permitted per year, one litter in March and the second in September. Seven and one-half pigs were assumed farrowed per litter or 15 pigs farrowed per sow per year. It was assumed that 1.5 hogs were retained per two litters as replacement stock, while the rest of the pigs were assumed fed and marketed along with the cull sows, the non-breeders and one 400-pound boar.

Irrigation Activities. As has been mentioned previously, the division made concerning the two irrigated farm situations resulted in what was called a "one-well" farm situation and a "two-well" farm situation.

It was assumed that an average well in the southwestern area would pump about 1,200 gallons per minute, which is equivalent to about 2.1 acre inches per hour or about 1,260 acre inches per month.[6] This figure of 1,260 acre inches per month was the constraint figures placed on the amount of water a farm could use each month per well.[7] This meant, of course, that the "two-well" farm had 2,500 acre inches of water available each month.

In setting up the monthly water requirement coefficients on the various irrigated crops, it was assumed that the watering was being done under very dry conditions. This, it seemed was the logical assumption to make since it seemed reasonable that farmers would make cropping

---

[6] It was further assumed that the well pump was running 20 hours per day per month. (4 hours a day were spent in making settings.)

[7] Just the months of July and August were actually used in the model because in these two months the greatest amount of water would be used. Therefore, if any month's water supply was going to be exhausted it would be one of these months.

decisions under the assumption of a dry year when deciding how much land they could irrigate with the given water supply. This will cause the July and August water intensive crop to be limited because the water use coefficients are largest during July and August for irrigation purposes because of the well capacity assumed. Therefore, under the assumption of a dry year the July and August water intensive crop acreages will be much smaller than if a more optimistic view was assumed.

Selling and Buying Activities. The model recognized the feed products as either intermediate or final products. Only one-half of the feed grain production could be fed to livestock and the rest could be sold as a cash crop. Neither feed grain nor hay could be acquired except by production on the farm. Alfalfa hay could be sold as a cash crop. Silage, like hay, could not be purchased but must be produced on the farm and could not be sold as a cash crop.

Wheat must be produced within its allotment. It can not serve as an intermediate product such as feed grains, alfalfa, or silage that could be fed to livestock.

CHAPTER IV

ANALYSIS OF RESULTS

Small Irrigated Farm (No Hogs)

The most profitable organization for this type of farm for each of the price situations considered is shown in table 5. The profit figure in each case shows the return to land, labor and management. The average farm in this class had 329 acres of irrigated land, 54 A.U.M.'s[1] of native pasture land and 184 acres of dry land crop land. Of the crop land acres, 364 are in the government program allotment of which 216 is the new wheat allotment and the residual is feed grain allotment. No hogs were allowed to come into the program at any of the three price levels considered.

The three columns in table 5 represent the profit maximizing solutions obtained at the wheat loan price (column 1), the futures price (column 2) and the current price (column 3)[2] situations, respectively. The left-hand captions indicate the enterprises considered. For example, it can be seen that there are 28 acres of dry land grain sorghum produced and 158 acres of irrigated grain sorghum produced under the wheat loan price situation. At this same set of prices, 169 acres of irrigated

---

[1] A.U.M. refers to animal unit months of pasture. It indicates here, as throughout this paper, a unit measure as to how many cattle, the pasture available for each of the farm classes, will support.

[2] The same price situations will be identified by the same column number throughout this chapter. Column 1 is the wheat loan price situation, column 2 is the futures price situation and column 3 is the current price situation.

wheat was indicated to be most profitable. An additional 27 acres of dry land wheat was indicated along with 57 acres of fallow land. At the wheat loan price situation 15,389 bushels of grain sorghum were produced; 364 hundredweight of beef was produced; 10,751 bushels of feed grains (in this case entirely sorghums) were sold and 7,450 bushels of wheat were produced and sold. To meet the roughage requirements of the 66 head of calves and 48 of fed steers, 22 acres of forage sorghum and 1 acre of irrigated corn silage were needed.

To achieve this organization shown in column 1, $7,736 of cash costs would be incurred. A total of $13,498 of operating capital would be used; all of this capital would be yielding at least 7 per cent rate of return. The return to land, operator labor, and management was $16,232.

In considering the futures price situation in column 2 of table 5 we see that the acreage of irrigated grain sorghums, irrigated corn, and irrigated wheat increased while dry land wheat and dry land grain sorghums decreased in acreage produced as compared to the wheat loan price situation. The higher wheat and feed grain prices probably were the cause of the shift from dry land production to more irrigated production. Under the futures price situation 38 acres of dry land grain sorghums were produced along with 72 acres of irrigated grain sorghums. At this same set of prices 30 acres of irrigated corn were produced, but under the wheat loan price situation no irrigated corn was produced. With the futures prices in effect 225 acres of irrigated wheat but no dry land wheat were found to be most profitable, but 18 acres of land were summer fallowed. In using the futures prices beef production was

513 hundredweight; also 7,510 bushels of grain sorghum along with 2,562 bushels of corn were produced; 4,998 bushels of feed grain were sold; and 9,780 bushels of wheat were produced and sold at the futures price level.

The higher beef price in the futures price situation, as compared to the wheat loan price situation, resulted in the number of calves raised to be increased to 82 head as well as an increase in the number of steers fed to 80. This indicates that all but two of the calves raised were also fed out in the dry lot. Under the wheat loan price situation a much smaller percentage of the calves raised were fed out in the dry lot. The higher beef price under the futures price situation made it much more profitable to feed more of the grain produced through the cattle than to sell it as a cash crop. In order to meet the roughage requirements of the cattle enterprises 30 acres of forage sorghums, one acre of irrigated corn silage and 2 acres of dry land sorghum silage were needed.

To realize the optimal organization shown in column 2, $8,264 of cash costs would result. A total of $13,498 of operating capital would be used, and the total return to land, operator labor and management would be $23,223. In comparing the futures price situation with the wheat loan price situation, by incurring about $500 more cash costs and investing about $3,000 more the small farm with no hogs can increase its return to land, operator labor, and management about $7,000.

Under the current price situation shown in column 3 of table 5 there were 28 acres of dry land grain sorghums produced, the same as under the wheat loan price situation, and 103 acres of irrigated grain

sorghums, which was more than produced under the futures price situation and less than produced under the wheat loan price situation. There was no irrigated corn produced under the current price situation. As was the case in the futures price situation, there were 225 acres of wheat planted but no dry land wheat planted under the current price situation. Also 61 acres of land were fallowed. At the current price situation 10,883 bushels of grain sorghums were produced; 8,949 bushels of feed grains (mostly grain sorghum) were sold and 9,589 bushels of wheat were produced and sold. When 153 hundredweight of beef produced under the current price situation is compared with the amount produced under the price situations in columns 1 and 2, we see that there was quite a decrease in beef production under the current price situation. Of the 35 calves raised, 12 were transferred from the calf enterprises to the fed steer enterprise and the remainder were sold as calves. Seven acres of forage sorghum and 1 acre of corn silage irrigated were grown in order to meet the roughage requirements of the beof produced.

This organization shown in column 3 was obtained by incurring $6,040 cash costs. The total amount of operating capital used was $8,490 and the total return to land, operator labor, and management was $21,358. The total return under the current price situation was about $2,000 less than under the futures price situation, but under the current price situation the cash costs were more than $2,000 less and the operating capital figure was about $8,000 less than the comparable figure under the futures price situation. But when the futures price situation is compared to the wheat loan price situation we see that even though that under the current price situation the cash costs are

TABLE 5

Optimal Solutions for the Small Farm Class With No Hogs
at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Sows farrowed[a]	head	0	0	0
Cattle fed:				
Calves[b]	head	66	82	35
Fed steers	head	48	80	12
Fallow land	acre	57	18	61
Amounts of crops produced:[c]				
Grain sorghum - dry	acre	28	38	28
Grain sorghum - irrigated	acre	158	72	103
Corn - irrigated	acre	0	30	0
Sorghum silage - irrigated	acre	0	0	0
Sorghum silage - dry	acre	0	2	0
Corn silage - irrigated	acre	1	1	1
Wheat - irrigated	acre	169	225	225
Wheat - dry	acre	27	0	0
Alfalfa - irrigated	acre	0	0	0
Forage sorghum - dry	acre	22	30	7
Grain and livestock production:				
Grain sorghum[d]	bushel	15,389	7,510	10,883
Corn	bushel	0	2,562	0
Pork sold	cwt	0	0	0
Beef sold	cwt	364	513	153
Feed grain sold	bushel	10,751	4,998	8,749
Wheat sold	bushel	7,450	9,780	9,589

TABLE 5 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Hog pasture	acre	0	0	0
Capital used:				
Cash costs	$	7,736	8,264	6,040
Operating capital	$	13,498	16,466	8,490
Return to land, operator labor and management	$	16,232	23,223	21,358

[a]No hogs were permitted to enter in this set of solutions.

[b]Calves can be transferred from the calf wintering operation to the feeder steer operation or sold.

[c]The acreage figures are in terms of acres planted.

[d]The figures for grain sorghum have not been adjusted to a corn equivalent value, as the "feed grain sold row" is.

about $1,500 lower and the operating capital figure is about $5,000 lower than those for the wheat loan price situation that the net return under the current price situation is about $5,000 greater than the net return under the wheat loan price situation.

Table 6 contains information relating to the number of livestock purchased and the extent to which the various restraints are limiting. For the wheat loan price situation in column 1 of table 6 it can be seen that 66 head of calves were purchased and no steers were bought. Thus, the 48 head of steers that were fed were first wintered and/or wintered and grazed, then transferred to the feed lot, the remaining 18 head of calves purchased were sold at the end of the wintering period.

In the remaining portion of the table, a dollar and cents figure indicates that the resource in question is limiting, a non-valued figure represents the extent to which the resource was not completely utilized. The value imputed to a limiting resource such as the $7.96 for crop land is often referred to as a "shadow" price. Economically, it is interpreted as being the marginal value product of the resource in question. Since a marginal value product of $7.96 was imputed to crop land, this means that if one more acre of crop land was made available the net returns would increase by that amount or, alternatively, if one acre less was available the net returns would be $7.96 lower. The marginal value product of an A.U.M. of pasture land was $5.88 under the wheat loan price situation and an additional acre of irrigated land would be worth $24.05 in net returns. The government program restriction serves to hinder the most profitable organization of the small irrigated farm class with no hogs as is indicated by the $3.75 value imputed to

TABLE 6

Numbers of Livestock Purchased and the Relative Importance of the Various Resource Constraints for the Small Irrigated Farm Without Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Purchases:				
Feeder calves	head	66	82	35
Feeder steers	head	0	0	0
Resource data:				
Crop land	acre	$ 7.97	$11.72	$11.55
Pasture land	A.U.M.	$ 5.88	$ 6.53	$ 6.02
Irrigated land	acre	$24.05	$38.03	$31.52
Government program allotment:	acre	$ 3.75	10	20
Wheat allotment	acre	34	$11.60	$16.37
Hired labor:				
January	hour	202	202	202
February	hour	199	199	199
March	hour	206	20	206
April	hour	212	212	212
May	hour	219	219	219
June	hour	202	182	173
July	hour	185	162	151
August	hour	230	232	223
September	hour	227	227	227
October	hour	105	62	221
November	hour	213	206	213
December	hour	203	195	202

TABLE 6 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Limit Grain sorghum fallow	acre	$ 4.15	$ 3.65	$ 0.90
Wheat pasture	A.U.M.	$ 0.01	$ 7.04	81
Livestock feed	bushel	4,930	910	4,579
August water	acre-inch	$ 0.80	439	439

the government program restraint. An additional relaxing of wheat allotments that would permit another acre of government program land would be worth $3.75. The additional allotment would not be used for wheat since 34 acres of land available for wheat were allocated to other uses. Rather at the price relationship present in the wheat loan price situation, the additional allotment would be allocated to grain sorghum. In other words not all of the wheat allotment was used for wheat production. Grain sorghums were substituted on wheat allotment acres.

Labor was not limiting in any of the labor periods. Labor was not hired up to the limit of the amount available in any month. Consequently labor shortages do not appear to be serious on the small irrigated farm without hogs.

Grain sorghum on fallow was not permitted to occupy more than 10 per cent of the total crop land. This is a restrictive limitation since a value of $4.15 was imputed to this restraint. Additional wheat pasture would add very little to help increase net returns. About one-half of the feed grains produced could have been fed but 4,930 bushels of potential feed was sold rather than fed.

The physical capacity of the irrigation well was also a real limitation to the organization of the small irrigated farm without hogs under the wheat loan price situation. An additional acre inche of water in August would be worth $0.80.

The same information, as was presented above for the wheat loan price situation is given in column 2 of table 6 for the futures price situation on small irrigated farms with no hogs. There were 82 head

of calves bought but no feeder steers were purchased. This result was general throughout the programming of these farm situations, that the calves were always purchased and no feeder steers were purchased. Some of the calves were usually transferred to the feed lot after the wintering period. Here in the futures price situation, as was seen before in table 5, 80 of these calves were transferred to the feed lot after being wintered.

The "shadow" prices of the three land categories for the futures price situation were higher than those under the wheat loan price situation. This was due mainly to the high price of wheat, feed grains and beef. Since there was a greater return to be made on a bushel of wheat or feed grain or a hundredweight of beef under the futures price situation as compared to the wheat loan price situation, naturally to have an additional acre of crop land, irrigated land or an additional A.U.M. of pasture would mean a greater return possible to the farmer. An additional acre of crop land would increase the returns to the small irrigated farm by $11.72, while additional A.U.M. of pasture land or one more acre of irrigated land would increase the returns by $6.53 or $38.03, respectively. To get the actual net return an acre of irrigated land would add, the $11.72 figure should be subtracted from the $38.03 figure because irrigated land is also included under crop land figures in the model. The government program restriction did not hinder the most profitable farm organization of the small irrigated farm under futures prices as it did under the wheat loan price situation. In fact column 2 shows that 10 acres of the government program allotment is used for something other than grain sorghums or wheat. Although under

the wheat loan price situation there was an excess amount of wheat allotment, under the futures price situation the wheat allotment is a restrictive factor in the optimal small irrigated farm organization. It has a "shadow" price of $11.60 imputed to it. If the wheat allotment was relaxed the additional allotment would be used for wheat production under the futures price situation and would not be allocated to grain sorghum as would have been the case under the wheat loan price situation.

As was the case under the wheat loan price situation, labor is not a limiting factor under the futures price situation. It would appear that the operator's labor is all that is needed except for some seasonal hired labor during the summer months and the grain sorghum harvesting period in October.

The grain sorghum on fallow constraint has a marginal value product of $3.65 imputed to it. The net returns that would be received for an additional A.U.M. of wheat pasture under the futures price situation of $7.04 were much greater than under the wheat loan price situation on small irrigated farms with no hogs. This would seem to have resulted from the increase in beef production which in turn resulted from an increase in the beef price. Also very little (only 910 bushels) of the feed grains that was available for livestock feed was sold. This too appears to have resulted from the increase in beef production.

The irrigation well's physical capacity is not a limiting factor to the optimal organization of the small irrigated farm under the futures price situation as it was for the wheat loan price situation.

In the current price situation in column 3 of table 6 we see that 35 head of feeder calves were bought but that no feeder steers were purchased. The "shadow" prices of the three land categories shown in column 3 were about the same as those for small irrigated farms under the futures price situation but larger than those under the wheat loan price situation. This would indicate that the land resource limitations were relatively more important under the current price situation for all three land categories than they were for the wheat loan price situation. Under the current price situation the marginal value product for crop land was $11.55, pasture land was $6.02 and irrigated land was $31.52. As in the futures price situation, the government program allotment restrictions did not restrict the most profitable farm organization under the current price situation. As shown in column 3, 20 acres of the government allotment were used for something other than wheat or grain sorghum. All of the wheat allotment was being used and was restrictive to the optimal solution under the current price situation as indicated by the $16.37 "shadow" price placed on the wheat allotment. The "shadow" price for the wheat allotment also indicated that this restriction was relatively more important in the optimal solution under the current price situation than it was under the futures price situation where the "shadow" price was only $11.60 on the wheat allotment restriction. The higher the "shadow" price on a restriction the relatively more important that restriction is in an optimal solution. An additional relaxing of the wheat allotment at the price relationship present in the current price situation would result in more wheat being produced.

As is also the case under the wheat loan price situation and the futures price situation for the small irrigated farms with no hogs, labor is not a limiting factor under the current price situation either. For the current price situation very little labor wae hired except during the summer months.

A value of only $0.90 was imputed to the grain sorghum on fallow constraint. This would indicate that not very much more grain sorghum on fallow would be planted even if there were no restriction placed on it. There were 81 A.U.M. of wheat pasture that were not used for grazing cattle. Although one-half of the feed grain production could have been fed to livestock, 4,579 bushels of this potential livestock feed was sold rather than fed under the current price situation. The irrigation well's physical capacity was not a limiting factor in the optimal farm organization. There were 439 available acre-inches of August water that were not ueed.

Small Irrigated Farm (With Hogs)

In table 7 the optimal farm solution values are shown for the three price situations considered for the small irrigated farm when hogs were considered in the farm plan. For reasons etated prior to this section of the paper, only 60 litters of hogs were allowed to come into the solution.

The three columns in table 7 show, as in table 5, the profit maximizing solutions obtained for the wheat loan price situation, the futures price eituation, and the current price situation, respectively. Under the wheat loan price situation in column 1 we see that 18 acres of grain sorghums were produced and 160 acres of irrigated grain

TABLE 7

Optimal Solutions for the Small Irrigated Farm Class With Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Sows farrowed [a]	head	30	30	30
Cattle fed:				
Calves [b]	head	33	51	29
Fed steers	head	0	27	0
Fallow land	acre	58	55	58
Amounts of crops produced: [c]				
Grain sorghum - dry	acre	18	18	37
Grain sorghum - irrigated	acre	160	78	117
Corn - irrigated	acre	0	80	0
Sorghum silage - irrigated	acre	0	0	0
Sorghum silage - dry	acre	0	0	0
Corn silage - irrigated	acre	0	1	0
Wheat - irrigated	acre	169	170	212
Wheat - dry	acre	40	40	17
Alfalfa - irrigated	acre	0	0	0
Forage sorghum - dry	acre	15	24	15
Grain and livestock production:				
Grain sorghum [d]	bushel	15,177	7,559	11,874
Corn	bushel	0	6,821	0

TABLE 7 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Grain and livestock production: (cont.)				
Pork sold	cwt	1,051	1,050	1,051
Beef sold	cwt	105	249	92
Feed grain sold	bushel	7,302	6,245	4,534
Wheat sold	bushel	7,743	7,714	9,001
Hog pasture	acre	12	12	12
Capital:				
Cash costs	$	10,438	11,771	10,007
Operating capital	$	13,123	16,374	12,632
Return to land, operator labor and management	$	28,803	30,371	33,908

[a]Limit to 30 sows farrowed twice a year.

[b]The calves are transferred from the calf wintering operation to either the feeder steer operation or sold.

[c]The acreage figures are in terms of acres planted.

[d]These figures are in actual bushels of grain sorghum and are not adjusted to their corn equivalent value as in the "feed grain sold" row.

sorghums were produced. For the same set of prices 40 acres dry land wheat were planted, 169 acres of irrigated wheat were planted and 58 acres of land were summer fallowed. Thus, under the wheat loan price situation 15,177 bushels of grain sorghum were produced, 7,302 bushels of feed grain were sold, and 7,743 bushels of wheat were produced and sold.

Of the 33 head of calves that were either wintered and/or, wintered and grazed, none of them were transferred to the feed lot. No fed steers were produced. To meet the roughage requirements of the beef cattle 15 acres of forage sorghums were raised. The 30 sows that were farrowed twice were the maximum number of sows that were allowed to come into the optimal solution. Twelve acres of hog pasture were required to pasture the hogs that were produced. Livestock production totaled 105 hundredweight of beef sold and 1,051 hundredweight of pork sold.

To maintain the organization shown in column 1 for this pessimistic wheat price situation, $10,438 of cash costs would be realized during the farming year. A total of $13,123 of operating capital would be required. As before, this operating capital would be yielding at least a 7 per cent rate of return. The net return to land, operator labor and management would be $28,803.

For the futures price situation in column 2 of table 7, it can be seen that, as under the wheat loan price situation in column 1, 18 acres of dry land grain sorghums were planted. Also 78 acres of irrigated grain sorghums were raised along with 80 acres of irrigated corn. Actually the total acreage of feed grain crops for the wheat loan price situation and the futures price situation differ very little. At the

same set of prices 40 acres of dry land wheat were planted along with 170 acres of irrigated wheat. There was a change of only one acre in the amount of wheat planted between column 1 and column 2. There were 56 acres of land summer fallowed. As result under the futures price situation 7,559 bushels of grain sorghums were produced; 6,821 bushels of corn were produced; 6,245 bushels of feed grains were sold and 7,714 bushels of wheat were produced and sold.

The most profitable number of calves was 51 and it was also indicated in the optimal solution that 27 head of these calves be transferred to the fed steer enterprise and be fed out on dry lot. Beef production from the beef enterprises was 249 hundredweight under the futures price situation. As under the wheat loan price situation, the maximum number of sows (30) were farrowed in the futures price situation.

As in the wheat loan price situation, only the government program allotment was exhausted while there were 24 acres of wheat allotment not used for wheat production. Since the government program allotment was used up and the wheat allotment was part of the total government program, this 24 acres of extra wheat allotment was used for feed grain production. Therefore the feed grain allotment is exceeded by 24 acres, since the total of the feed grain allotment and the wheat allotment make up the total government program allotment.

From the hog enterprises, 1,051 hundredweight of pork were produced. About 24 acres of forage sorghums and one acre of corn silage were produced to meet the necessary roughage requirements for the livestock enterprises. The hog enterprise also required 12 acres of hog pasture.

To achieve the farm organization for the futures price situation of the small irrigated farm class with hogs $11,771 of cash costs would result. A total of $16,374 of operating capital would be needed. The above expenditures along with the necessary labor and land resulted in a net return to land, operator labor and management of $30,371. The returns under the futures price situation were about $2,000 greater than those under the wheat loan price situation, but the operating capital is larger by about $3,000 and the cash costs are larger by about $4,500 under the futures price situation as compared to the wheat loan price situation.

In column 3 of table 7 is shown the optimal farm organization for the small irrigated farm class with hogs under the current price situation. Under this price situation 37 acres of dry land grain sorghums were produced. Also 117 acres of irrigated grain sorghums were found to be most profitable. The amount of irrigated wheat increased over what it was in both columns 1 and 2 to 212 acres, although the amount of dry land wheat that was optimum dropped to 17 acres under the current price situation. There were also 58 acres summer fallowed. At the current price situation 11,874 bushels of grain sorghums were produced; 4,534 bushels of feed grains were sold and 9,001 bushels of wheat were produced and sold.

From the 29 head of calves 92 hundredweight of beef were produced. There were no fed steers produced. Beef production under the current price situation for the small irrigated farm class with hogs was the smallest of the three price situations considered for this farm class. Hogs came in to the limit as they did under the wheat loan price

situation and the futures price situation. The 1,051 hundredweight of pork produced is the same, therefore, as it was in columns 1 and 2. Both the government program allotment and the wheat allotment were exhausted under the current price situation.

To meet the roughage requirements for the beef and hog enterprises, 15 acres of forage sorghums were raised along with 12 acres of hog pasture. But to attain this farm organization shown in column 3, $10,007 of cash costs would be incurred. Also a total of $12,632 of operating capital would be needed. The net return to land, operator labor and to management would be $33,908, which was the highest return that would be received under any of the three price situations considered for the small irrigated farm class with hogs.

Table 8 is similar to table 6. It contains information showing the number of livestock purchased and the relative importance of the various restraints that are limiting at the three price situations shown. At the wheat loan price situation in column 1 it shows that 29 head of calves were purchaeed. As was mentioned previously and it is true here also, that none of the calves were raised through a beef cow herd. All three typee of the land resources were limiting. The value imputed to crop land was $7.37; to an A.U.M. of pasture was $5.10 and to irrigated land was $23.52.

The government program allotment restriction hindered the optimal farm organization as is indicated by the $3.95 marginal value product figure imputed to it, but the wheat allotment had 20 acres that were not used for wheat production. But since the government program allotment was used up completely and the wheat allotment figure is part of the

TABLE 8

Numbers of Livestock Purchased and the Relative Importance of the Various Resource Constraints for the Small Irrigated Farm With Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Purchases:				
Feeder calves	head	29	51	33
Feeder steers	head	0	0	0
Resource data:				
Crop land	acre	$ 7.37	$ 9.90	$ 11.68
Pasture	A.U.M.	$ 5.10	$ 7.76	$ 4.87
Irrigated land	acre	$ 23.52	$ 36.98	$ 38.09
Government program allotment	acre	$ 3.95	$ 9.01	$ 1.90
Wheat allotment	acre	26	24	$ 6.55
Hired labor:				
January	hour	202	202	202
February	hour	199	199	199
March	hour	111	62	133
April	hour	143	129	176
May	hour	139	142	138
June	hour	147	97	131
July	hour	126	144	105
August	hour	160	185	160
September	hour	161	129	161
October	hour	161	17	172
November	hour	213	213	213
December	hour	203	188	202

TABLE 8 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Activities data:				
Sow and litter I	litter	$406.98	$217.38	$352.38
Sow and litter II	litter	$411.13	$223.76	$356.53
Limit grain sorghum fallow	acre	$ 3.95	$ 1.19	$ 1.99
Wheat pasture	A.U.M.	65	34	88
Livestock feed	bushel	1,569	$ 0.19	$ 0.27
July water	acre-inch	644	$ 0.04	420
August water	acre-inch	$ 0.69	44	335

government program allotment, grain sorghums were substituted for wheat on the wheat allotment. An additional acre of wheat allotment that would have allowed another acre of government program allotment would not be used to grow another acre of wheat since 26 acres of wheat allotment were not used for wheat. The additional acre would be used for grain sorghum production at the price relationships presented in column 1.

Labor was not hired up to the limit in any month, thus it was not a limiting resource on the small irrigated farm with hogs. Consequently, even with the labor intensive hog enterprise present in the farm organization, labor shortages do not appear to be serious on the small irrigated farms.

Under the wheat loan price situation the two sow littsr hog enterprise have very high "shadow" prices of $406.98 and $411.13. This indicates that if one more litter of hogs were raised for sow-litter enterprise I $406.98 would be added to net returns. These high "shadow" prices indicate that if a limit had not been placed on hog production probably quite a few more hogs would have been raised. If an additional acre of grain sorghum on fallow would have been allowed, $3.95 would have been added to net returns. There were 65 acres of wheat pasture that were not grazed at all. Although one-half of the feed grain production was available to be used as livestock feed, 1,569 bushels of potential livestock feed was sold rather than fed.

The irrigation well's physical capacity was also limiting to the optimal farm organization under the wheat loan price situation. One more acre-inch of water would add $0.69 to net returns.

For the futures price situation in column 2 of table 8, we see that 51 head of calves were purchased but no fed steers were purchased. As was mentioned in discussing column 2 of table 7, 27 of these 51 calves were profitably transferred to the fed steer enterprise. The marginal value products of the land categories are higher under this price situation than under the wheat loan price situation and were probably the result of higher wheat and feed grain prices. The marginal value product of crop land was $9.90; for additional A.U.M. of pasture the marginal value product was $7.76; while the marginal value product for one more acre of irrigated land was $36.98. Basically the same situation exists concerning the government program allotments and wheat allotment as was described for the wheat loan price situation in column 1. The only differences were that the "shadow" price of the government program allotment was $9.01 and there were 24 acres of excess wheat allotment on which grain sorghum was substituted.

Labor was not a limiting factor on the farm organization under the futures price situation either. But in several of the labor periods for the futures price situation, the labor amounts unused were not so excessive. This was especially so for the October labor period as compared to the same labor period at the wheat loan price situation.

The lower "shadow" prices of the two hog enterprises were reflected partly by the lower hog price under the futures price situation. Because of the lower hog price an additional two litters of hogs under either hog enterprise would not be as profitable as they were under the wheat loan price situation. An additional acre of grain sorghum or fallow would only add $1.19 to net returns. The A.U.M.'s of wheat pasture

that were not grazed is smaller under this price situation than it was for the wheat loan price situation due mostly to the increased amount of calves purchased and grazed. Under the futures price situation for small irrigated farms with hogs all of the potential livestock feed was fed through the livestock enterprises and none of it was sold before being fed. An extra bushel of livestock feed would increase returns by $0.27.

Under the futures price situation August irrigation water was not a limiting resource, but July water was for the first time in any of the optimal solutions considered so far in this analysis. This was probably due to the large amount of irrigated corn raised under the futures price situation. Corn required more July water than it did August water. An additional acre-inch of July water would add $0.04 to returns.

At the current price situation shown in column 3, 33 calves were purchased and no feeder steers were bought. But the "shadow" prices for the three land constraints were higher than they were under either the wheat loan price situation or the futures price situation except for pasture land. This would indicate that the land limitation under the current price situation was more important than under either of the other price situations. The "shadow" prices were $11.68 for crop land, $4.87 for an A.U.M. of pasture and $38.09 for irrigated land. Both the government program allotment and the wheat allotment were limiting for small irrigated farms under the current price situation. An additional acre of government program allotment would add $1.90 to returns while an additional acre of wheat allotment would add $6.55 to returns.

Again labor was not a limiting resource for the optimal farm organization. Additional labor was not needed, but additional land could be profitably employed.

An additional two litters of hogs raised under the sow and litter I enterprise would increase net returns by $352.38, and an additional two litters raised under the sow and litter II enterprise would add $356.53 to net returns to land, operator labor and management. Again, as under the other price situations discussed in table 8, the hog "shadow" prices were quite large compared to the "shadow" prices of other resource constraints. Actually the "hog constraint" is an activity constraint and not a resource constraint. The marginal value product of grain sorghum on fallow was $1.99. As result of lower cattle numbers than was the case under the futures price situation and more wheat being raised than under the wheat loan price situation, the excess 88 A.U.M.'s wheat pasture under the current price situation was larger than the corresponding figure for the price situations in columns 1 and 2. The irrigation well's physical capacity was not a limiting factor in the optimal farm organization for the small irrigated farm class with hogs at the current price situation.

Comparison

The comparisons made in this section will be concerned with comparing some of the differences in the optimal farm organizations between the small irrigated farm without hogs and the small irrigated farm with hogs under the three price situations that have been discussed in the

analysis of these two farms.[3] We will be comparing mainly tables 5 and 7.

The real thing we are interested in this study and the thing we assumed the farmer should be aiming for was to maximize profits. It can be seen in table 7 that under all three price situations programmed, the net return figure is greater than the corresponding net return figures for the same price situations in table 5. This would seem to indicate that when the hog enterpriee was added to the farm organization net returns were increased considerably.

If the net return figure in column 1 of table 7 is compared with the corresponding figures in column 1 table 5, for example, it can be seen that the net return figure in column 1 of table 7 is about $12,000 larger than the corresponding figure in table 5. The only difference between the two results is that in table 7 hogs were allowed to come into the solution and in table 5 they were not allowed to come into the solution. The $12,000 increase in net returns to land, labor and management can, it would seem, be rightfully credited to the hog enterprise. There was practically no difference between amount of grain sorghums and wheat produced for the two wheat loan price situations shown in tables 5 and 7. One difference was that in table 5, at the wheat loan price situation, 10,751 bushels of feed graine were sold for cash while for the eame price situation in table 7 only 7,302 buehels

---

[3]These two farms are not actually two different farm classes. Both are programmed as small irrigated farms, one without hogs and one with hoge. There are only really two farm classes in this study, small irrigated farms and large irrigated farms. The two small farms programmed will be called farm situations in the text.

of feed grains were sold. The difference may be mainly attributed to the feed that was fed to the hogs.

Labor was not a limiting factor in either of the farm situations even when the labor intensive hog enterprises were allowed to come into the small irrigated farm organization.

In both situations irrigated corn was produced at the futures price situation but not under the other two price situations. At all price situations the amount of beef produced for small irrigated farms without hogs was larger than the amount of beef production that was profitable for the small irrigated farm with hogs. It would seem that hogs competed somewhat with the cattle enterprise for some of the available but limiting resources, mainly the livestock feed. The amount of forage sorghums raised varied directly with the amount of beef production that resulted.

In comparing tables 6 and 8 we see that, in general, there was not very much difference in the relative importance of the land limiting factor since the "shadow" prices for the three main land categories do not actually differ very much overall for the with and without hog situations for this small irrigated farm class. One difference that may be noted is that in table 8 it can be seen that in every price situation the government program allotment is used up, while in table 6 it is used up only under the wheat loan price situation. This means that in table 8, which shows the small irrigated farm situation with hogs, the feed grain base is at least fully used up every time, while in table 6, which shows the small irrigated farm situation without hogs, it is used up only under the wheat loan price situation. This would

seem to indicate that with hogs allowed to come into the optimal solution more feed grains are produced. There was no difference between the two wheat loan price situations of any consequence, but under the futures price situation and the current price situation in table 8, the amount of feed grains produced is larger than for the same two price situations in table 6. The grain sorghum fallow restriction is limiting in both the with and without hog situations.

Large Irrigated Farm (No Hogs)

The optimal solution values for the wheat loan price situation, the futures price situation and the current price situation are found in table 9. The average farm in this class has 574 acres of irrigated land, 385 acres of pasture land, and 1,135 acres of dry land crop land. Of the total crop land figure 1,218 acres was the government program allotment. Of the government program allotment 723 acres represent the wheat allotment and the remainder was the feed grain allotment. These were the land constraints used. No hogs were permitted to come into the solution.

The three columns in table 9 represent the optimal or profit maximizing solutions for the three price levels mentioned previously in the preceding paragraph. The format of table 9 is similar to that of table 5. Under the wheat loan price situation (column 1) 146 calves were either wintered and/or wintered and grazed but no steers were fattened out in the dry lot. The calves were sold at the end of the wintering and/or wintering and grazing period. The production of the 466 hundredweight of beef necessitated the production of 31 acres of

TABLE 9

Optimal Solutions for the Large Irrigated Farm Class With No Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Sows farrowed[a]	head	0	0	0
Cattle fed:				
Calves [b]	head	146	169	62
Fed steers	head	0	73	0
Fallow land	acre	393	386	387
Amounts of crops produced:[c]				
Grain sorghum - dry	acre	381	197	198
Grain sorghum - irrigated	acre	320	311	290
Corn - irrigated	acre	0	0	0
Sorghum silage - irrigated	acre	0	0	0
Sorghum silage - dry	acre	0	0	0
Corn silage - irrigated	acre	0	9	0
Wheat - irrigated	acre	254	254	284
Wheat - dry	acre	340	544	546
Alfalfa - irrigated	acre	0	0	0
Forage sorghum - dry	acre	31	16	13
Grain and livestock production:				
Grain sorghum [d]	bushel	37,928	33,432	31,583
Corn	bushel	0	0	0
Pork sold	cwt	0	0	0
Beef sold	cwt	466	773	198
Feed grain sold	bushel	32,238	24,793	26,845
Wheat sold	bushel	15,473	17,579	18,784

TABLE 9 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Hog pasture	acre	0	0	0
Capital:				
Cash costs	$	15,059	16,279	12,798
Operating capital	$	25,603	30,947	15,261
Return to land, operator labor and management	$	36,685	50,697	46,451

[a]No hogs were permitted to enter in this set of solutions.

[b]The calves are transferred from the calf wintering operation to either the feeder steer operation or sold.

[c]The acreage figures are in terms of acres planted.

[d]These figures are in the unadjusted form, i.e., they have not been adjusted to their corn equivalent value as the "feed grain sold" row is.

forage sorghums to meet the calves' roughage requirements. All of the feed grain production consisted of grain sorghums. Under the wheat loan price situation there were 381 acres of dry land grain sorghums produced along with 320 acres of irrigated grain sorghums. For this same set of prices 254 acres of irrigated wheat were indicated to be optimal. Also an additional 340 acres of dry land wheat was indicated to be most profitable. There were 393 acres summer fallowed. At the wheat loan price situation 37,928 bushels of grain sorghums were produced and 15,473 bushels of wheat were produced and sold. Since the wintered calf enterprise and the wintered and grazed calf enterprise used a very small amount of feed grains, there were 32,238 bushels of feed grains sold on the cash grain market at the $1.10/bushel feed grain price.

To attain the large irrigated farm organization shown in column 1, $15,059 of cash costs were incurred. A total of $25,498 of operating capital were needed. The net return to land, operator labor and management was $36,685.

For the futures price situation in column 2 of table 9, there were 197 acres of dry land grain sorghums produced in addition to 311 acres of irrigated grain sorghums. Both of these grain sorghum acreage figures are lower than those under the wheat loan price situation even though the price of feed grains increased. The reason for this may be partially seen when we discuss table 10. The amount of irrigated wheat planted remains the same as it was under the wheat loan price situation at 254 acres, but the amount of dry land wheat planted under the futures price situation increases to 544 acres. The number of acres fallowed

was 386. Also under the futures price situation 33,432 bushels of grain sorghum were produced; 24,793 bushels of feed grains were sold and 17,579 bushels of wheat were produced and sold. The optimal number of calves for the large irrigated farm with no hogs was 169 head. Of that 169 head of calves it was most profitable to transfer 73 of them to the fed steer enterprise to feed them out in the dry lot. The balance of the calves were sold after the wintering and/or winter and graze period. The beef cattle enterprises produced 733 hundredweight of beef which was an increase of more than 30,000 pounds over the beef production under the wheat loan price situation. The most profitable way to produce the roughage needed by the beef enterprise under the futures price situation was to produce 16 acres of forage sorghum along with 9 acres of irrigated corn silage.

To achieve the organization shown in column 2, $16,279 of cash costs would be incurred. A total of $30,947 of capital would be used while the net return to land, operator labor and management would be $50,697.

Under the current price situation in column 3 we see that 198 acres of dry land grain sorghums were planted along with 290 acres of grain sorghums which were under irrigation. The dry land acreage is almost the same as under the futures price situation but the acreage of irrigated grain sorghums is 21 acres less than it was under the futures price situation. But both the dry land and irrigated wheat acreages have increased over what they were under the futures price situation. For the current price situation in column 3 we see that 284 acres of irrigated wheat were planted and 546 acres of dry land were planted.

Also 387 acres were summer fallowed. At the current price level 31,845 bushels of grain sorghums were produced; 26,845 bushels of feed grains were sold and 18,784 bushels of wheat were produced and sold. The 62 calves that were either wintered and/or wintered and grazed were quite a drop in calf numbers when compared to either the futures price situation or the wheat loan price situation. As the result of the drop in the number of beef cattle under the current price situation, only 198 hundredweight of beef were produced and only 13 acres of forage sorghum were needed to meet the roughage requirements of the beef cattle enterprises.

In attaining the optimal organization on the large irrigated farms, $12,798 of cash costs would be incurred. The operating capital needs were $15,261. The net return to land, operator labor and management would be $46,451. In comparing the cash costs, operating capital, and net return under the current price situation with the futures price situation and the wheat loan price situation for the large irrigated farm class, we see from table 9 that both the cash costs and the operating capital figures were lower in column 3 than in either column 1 or 2. But the net return figure under the current price situation was $10,000 above the net return figure in column 1 and $4,000 below the net return figure for the futures price situation in column 2.

As table 6, table 10 contains information relating to the numbers of livestock purchased and the extent to which the various constrainte are limiting. In the wheat loan price situation shown in column 1 of table 10 it can be seen that 146 feeder calves were purchased while no feeder steers were purchased. Therefore, of the calves fed under the

TABLE 10

Numbers of Livestock Purchased and the Relative Importance of the Various Resource Constraints for the Large Irrigated Farm Without Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Purchases:				
Feeder calves	head	146	169	62
Feeder steers	head	0	0	0
Resource data:				
Crop land	acre	$ 7.26	$ 1.48	$ 0.36
Pasture land	A.U.M.	$ 3.71	$ 1.16	299
Irrigated land	acre	$21.90	$19.39	$19.84
Government program allotment	acre	79	98	97
Wheat allotment	acre	226	90	60
Hired labor:				
January	hour	404	335	404
February	hour	398	329	398
March	hour	319	206	413
April	hour	100	120	251
May	hour	47	180	204
June	hour	$ 6.62	$41.28	$44.89
July	hour	90	111	107
August	hour	189	176	184
September	hour	260	209	253
October	hour	36	$ 5.06	254
November	hour	273	209	410
December	hour	290	193	401

TABLE 10 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Limit grain sorghum fallow	acre	$ 5.28	$ 9.20	$ 7.62
Wheat pasture	A.U.M.	47	20	192
Livestock feed	bushel	18,017	12,256	15,002
August water	acre-inch	$ 0.87	$ 0.91	237

wheat loan price situation, none of them were raised through a cow herd.

The values imputed to the three land categories, crop land, an A.U.M. of pasture land and irrigated land were $7.26, $3.71 and $21.90, respectively. These values do not tend to be as high as those in the small irrigated farm class with no hogs. Under the wheat loan price situation neither the government program allotment nor the wheat allotment were limiting. There were 79 acres of the government program allotment not used for wheat or feed grains in the optimal solution. We also see that 226 acres of the wheat allotment was not used, but it should be kept in mind that the 723 acres in the wheat allotment for the large irrigated farm class is part of the total government program allotment. So we see that part of the wheat allotment acres were used for feed grain production (grain sorghums in this case). To determine the actual amount of the wheat allotment acres that are used for grain sorghum we can substract 79 from 226 and we see that 147 acres of the wheat allotment had grain sorghums substituted for the wheat on them. To determine what the actual amount of the wheat allotment that was used for wheat production we substract 226 from 723, the "new" wheat allotment, and we see that 497 acres of wheat allotment was actually used. This was less than the old wheat allotment of 567 acres.

June labor was limiting. By this it is meant that all the June labor that was available (both operator and hired) was all used up. The "shadow" price for the June labor period was $6.62 (also called the marginal value product of June labor). This means that if one more hour of June labor was available it would add $6.62 to the return. Assuming this hour of labor would only cost $1.31 if it was hired, this $1.31

would be the marginal cost, economically speaking, of one hour of hired labor. Since the marginal value product is greater than the marginal cost, it would definitely be advantageous to use the extra hour of labor if it were available. None of the other labor periods were limiting but it can be noticed that the excess amounts of May and October labor were quite small.

Grain sorghum on fallow was a restrictive limitation. Since the marginal value product imputed to this restraint was $5.28 one more acre of grain sorghum raised on fallow ground would increase net returns $5.28. There were 47 A.U.M.'s of wheat pasture that were not used for grazing purposes. Of the available livestock feed 18,017 bushels, or most of it, was not fed but sold on the cash market.

Under the wheat loan price situation for the large irrigated farms with no hogs the physical capacity of the wells were also a real limitation to the farm organization. The marginal value product of an additional acre-inch of August water was $0.87.

For the futures price situation in column 2 of table 10 we see that 169 head of feeder calves and no feeder steers were purchased. The marginal value product imputed to an acre of crop land was $1.48; to pasture land $1.16/A.U.M. and to an acre of irrigated land was $10.39. The crop land value, especially, was quite a little lower than the corresponding value under the wheat loan price situation. The imputed values to pasture land and irrigated land are also smaller under the futures price situation than they were under the wheat loan price situation. These lower marginal value product figures would indicate that the relative importance of the land restrictions under the futures price

situation are less important than those under the wheat loan price situation.

There were 98 acres of the government program allotment that were not used for wheat or grain sorghums but for some other crop. Also there were 90 acres of wheat allotment that were not used for wheat production. Thus grain sorghums were not substituted on any of the wheat allotment land because the amount of excess government program land was larger than the amount of excess wheat allotment land.

In the futures price situation for the large irrigated farms with no hogs, both June and October labor were limiting. The "shadow" price for June labor was $41.28 and for October labor it was $5.06. The June labor's "shadow" price was quite high, indicating that the lack of June labor is quite restrictive on the optimal farm organization under the futures price situation. This no doubt limits the amount of wheat that is produced because June labor is needed in harvesting the wheat as can be seen in table A in the Appendix. The labor requirements by months for each crop enterprise is also shown in table A (Appendix).

The grain sorghum on fallow constraint was limiting with a marginal value product imputed to it of $9.20. There were 20 A.U.M.'s of wheat pasture not grazed which is less than under the wheat loan price situation. This was due to the fact that more beef was produced under the futures price situation than under the wheat loan price situation. Of the potential livestock feed 12,256 bushels were sold instead of being fed under the futures price situation. Well pumping capacity was also limitational. An additional acre-inch of August water would be worth $0.91.

More of the "new" wheat allotment was used under the futures

price situation shown in column 2, than under the wheat loan price situation for the large irrigated farm class with no hogs. If we substract 90, the excess wheat allotment from 723, the "new" wheat allotment, we see that wheat was raised on 633 acres of the available 723 acres of wheat allotment. Thus, part of the allowed increase in wheat allotment was used for wheat production, since the old wheat allotment was 567 acres.

Column 3 of table 10 shows the number of livestock purchased and the relative importance of the various limiting restraints for the current price situation. At the current price situation 62 head of feeder calves were purchased and no feeder steers were bought. The marginal value product imputed to crop land was only $0.36. This is very low and it would not make much difference in the net returns whether another acre of crop land was utilized or not. Of the pasture land available 299 A.U.M.'s were not used for grazing under the current price situation. The "shadow" price for irrigated land was $19.84.

At the current price situation there were 97 acres of excess government program allotment and also 60 acres of wheat allotment that were not used for wheat production. As under the futures price situation, no grain sorghums were substituted on wheat allotment land under the current price situation. In column 3, by substracting 60 from 723, we see that 663 acres of the available 723 acres of wheat allotment were used to produce wheat. Thus, all but 60 acres of the "new" wheat allotment were used for wheat production.

For the current price situation the June labor was limiting. It had a "shadow" price of $44.89. This "shadow" price was the largest for

June labor of the three price situations considered. In other words the shortage of the supply of June labor under the current price situation was relatively more important than under either the wheat loan price situation or the futures price situation in columns 1 and 2.

The grain sorghum fallow constraint had a "shadow" price of $7.62 under the current price situation. There were 192 A.U.M.'s of wheat pasture not grazed which resulted from the smaller amount of beef produced under the current price situation than under either of the other two price situations. There were 15,002 bushels of potential livestock feed that were not fed but was sold. The August water was not a limiting factor in the farm organization under the current price situation for the large irrigated farms with no hogs.

Large Irrigated Farm (With Hogs)

The large irrigated farms were also programmed with the potential for hogs to enter the farm organization at the three price situations. Table 11 shows the optimal solution for each of the price situations programmed. Again the amount of hogs that could be raised was limited to 30 sows farrowed twice a year, or in other words it was limited to 60 litters per year.

In column 1 of table 11, which shows the optimal farm organization for the large irrigated farm class with hogs under the wheat loan price situation, we see that 293 acres of dry land grain sorghums were planted while 319 acres of irrigated grain sorghums were also planted. Under this same set of prices 254 acres of irrigated wheat were indicated to

TABLE 11

Optimal Solutions for the Large Irrigated Farm Class With Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Sows farrowed[a]	head	30	30	30
Cattle fed:				
Calves[b]	head	140	149	0
Fed steers	head	0	47	0
Fallow land	acre	334	335	377
Amounts of crops produced:[c]				
Grain sorghum - dry	acre	293	182	194
Grain sorghum - irrigated	acre	319	312	320
Corn - irrigated	acre	0	0	0
Sorghum silage - irrigated	acre	0	0	0
Sorghum silage - dry	acre	0	0	0
Corn silage - irrigated	acre	0	8	0
Wheat - irrigated	acre	254	254	254
Wheat - dry	acre	307	442	525
Alfalfa - irrigated	acre	0	0	0
Forage sorghum - dry	acre	36	17	8
Grain and livestock production:				
Grain sorghum[d]	bushel	36,089	33,200	34,154
Corn	bushel	0	0	0
Pork sold	cwt	1,051	1,051	1,051
Beef sold	cwt	448	625	0
Feed grain sold	bushel	25,034	20,223	23,391
Wheat sold	bushel	14,721	16,142	17,309

TABLE 11 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Hog pasture	acre	12	12	12
Capital:				
Cash costs	$	18,631	19,324	16,135
Operating capital	$	30,022	32,652	13,097
Return to land, operator labor and management	$	47,181	55,768	56,387

[a]Limited to 30 sows farrowed twice a year.

[b]The calves are transferred from the calf wintering operation to either the feeder steer operation or sold.

[c]The acreage figures are in terms of acres planted.

[d]These figures are in actual bushels of grain sorghum and are not adjusted to their corn equivalent value as in the "feed grain sold" row.

be most profitable. Also an additional 307 acres of dry land wheat were planted and there were 334 acres fallowed. Thus at the wheat loan price situation 36,089 bushels of grain sorghums were produced, 25,034 bushels of feed grains were sold and 14,721 bushels of wheat were produced and sold.

As was the case for the small irrigated farm class with hogs, hogs came into optimal farm organization at the maximum amount of 30 sows being farrowed twice a year. As result there was 1,051 hundredweight of pork produced under the wheat loan price situation. About 12 acres of hog pasture were needed for the hog enterprise. In the beef production 448 hundredweight of beef were produced from the 140 calves that were just wintered and/or wintered and grazed. There was no beef production resulting from the feeder steer enterprise, since no steers were fed on the dry lot under the wheat loan price situation. Under this level of beef production 36 acres of forage sorghum were required to meet the roughage requirements of the beef enterprise.

To achieve this optimal farm organization under the wheat loan price situation $18,631 of cash costs would be realized. A total of $30,022 of operating capital would be needed. The end result of the large irrigated farm business would be a return of $47,181 to land, operator labor and management.

In the optimal farm organization under the futures price situation for large irrigated farms with hogs shown in column 2 of table 11, it was indicated to be most profitable to plant 182 acres of dry land grain sorghums along with 312 acres of irrigated grain sorghums. Also, as under the wheat loan price situation for this farm class, 254 acres of

irrigated wheat were planted. Also an additional 442 acres of wheat on dry land was indicated. It should be noticed here that although the wheat price increased from $1.17/bushel in column 1 to $1.70 in column 2 the increase in wheat production that would be expected did not come through the irrigated wheat enterprises but through the dry land wheat enterprises. As result of planting these crop acreages 33,200 bushels of grain sorghums were produced; 20,223 bushels of feed grains were sold and 16,142 bushels of wheat were produced and sold.

Hogs came into the optimal solution to the maximum amount possible--30 sows farrowed twice a year. As under the wheat loan price situation in column 1, this resulted in 1,051 hundredweight of hogs being produced under the futures price situation and also 12 acres of hog pasture being needed for the hog production. There were 625 hundredweight of beef produced at the futures price level through the 149 head of calves and 47 head of fed steers indicated in the optimal solution. Since no feeder steers were purchased, the 47 fed steers were transferred to the fed steer enterprise from the calf enterprises. In meeting the roughage requirements of the beef enterprises for the large irrigated farms with hogs under the futures price situation, 17 acres of forage sorghum and 8 acres of irrigated corn silage were produced.

To maintain the optimal organization shown under the futures price situation for the large irrigated farms with hogs in column 2, it would result in cash costs of $19,324 and a total of $32,652 of operating capital would be needed. As has been true for each price situation all the way through this analysis, the operating capital must be yielding a rate of return at least equal to 7 per cent. The net returns to land,

operator labor and management would then be $55,768. This net return figure is about $5,000 larger than the corresponding net return figure at the futures price situation for the large irrigated farm class with no hogs shown in table 9 column 2. But the cash coets figure ie about $3,000 larger for the with hoge eituation than the without hoge situation and the operating capital figure is about $2,000 larger for the with hog situation than the without hog situation both at the futures price level. This comparison would seem to indicate that the added return for raising hogs under the futures price eituation on large irrigated farms was not as great as the return for raising hogs under the wheat loan price eituation for the same farm class.

The current price situation, which is ehown in column 3 of table 11, indicated that under this price situation for the optimal farm organization for large irrigated farms with hogs 194 acres of dry land grain sorghums and 320 acres of irrigated grain sorghume were planted. Also 254 acres of irrigated wheat were planted along with 525 additional acree of dry land wheat. Also 377 acres were fallowed. Thue at the current price situation 34,154 bushels of grain sorghums were produced, 23,391 buehele of feed grains were sold and 17,309 buehele of wheat were produced.

Hogs again came into the optimal eolution at the maximum amount possible of 60 littere per year. As wae trus under the wheat loan prioe situation and the futuree price situation, 1,051 hundredweight of pork was produced at the current price eituation for the large irrigated farms with hogs. Under the current price situation no beef was produced. But to meet the hogs' roughage requirements 8 acree of forage sorghum were

raised along with 12 acres of hog pasture.

To achieve this optimal farm organization indicated under the current price situation in column 3, $16,135 of cash costs would be incurred. A total of $13,097 of operating capital would be needed. The return to land, operator labor and capital would be $56,387. The seemingly low operating capital figure in column 3 is somewhat unusual especially when one compares it to the correeponding figuree in columns 1 and 2. In general comparing the optimal organizations of columns 1 and 2 with the optimal organization in column 3 the main difference would seem to lie in the fact that in columne 1 and 2 a large amount of beef was produced while in column 3 no beef production took place. This difference probably accounts for the low operating capital figure.

Table 12 contains information relating to the numbere of livestock purchased and the relative limiting effect the various resource constraints have on the optimal farm organization of the large irrigated farm class with hogs at the three price levels discussed above. For the wheat loan price situation in column 1 of table 12 we oan see that there were 140 head of feeder calves bought but no feeder steere were purchased. As was mentioned previously these calvee were either wintered and/or wintered and grazed.

In the resource data section of table 12 for oolumn 1 ehows that under the wheat loan price eituation 162 acree of crop land were not used or left idle. This indicates that the large farm with hoge at the wheat loan price eituation would be just as well off not to have 162 acres of crop land. To dispose of this 162 acres would not affect the optimal farm organization or the net return figure. With hogs in the

TABLE 12

Numbers of Livestock Purchased and the Relative Importance of the Various Resource Constraints for the Large Irrigated Farm With Hogs at the Three Price Levels Considered

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Purchases:				
Feeder calves	head	140	149	0
Feeder steers	head	0	0	0
Resource data:				
Crop land	acre	162	156	28
Pasture land	acre	$ 0.10	$ 0.70	385
Irrigated land	acre	$ 9.41	$11.83	$19.22
Government program allotment	acre	180	184	114
Wheat allotment	acre	254	164	104
Hired labor:				
January	hour	393	335	404
February	hour	351	294	398
March	hour	126	61	267
April	hour	28	47	186
May	hour	$ 2.03	88	120
June	hour	$29.02	$46.02	$46.07
July	hour	62	76	99
August	hour	134	129	153
September	hour	128	114	174
October	hour	$ 1.20	$ 5.31	299
November	hour	230	194	388
December	hour	240	186	401

TABLE 12 (continued)

Enterprise	Unit	Wheat loan price Wheat $1.17/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt	Futures price Wheat $1.70/bu Feed grain $1.20/bu Beef $28.39/cwt Pork $20.83/cwt	Current price Wheat $1.76/bu Feed grain $1.10/bu Beef $24.30/cwt Pork $24.50/cwt
Activities data:				
Sow and litter I	litter	$332.69	$155.73	$318.64
Sow and litter II	litter	$347.22	$175.54	$335.14
Limit grain sorghum fallow	acre	$ 11.27	$ 10.68	$ 8.02
Wheat pasture	acre	46	36	237
Livestock feed	bushel	11,502	7,774	10,583
August water	acre-inch	$ 1.90	$ 1.16	$ 0.07

farm organization in amount of 60 litters it would seem that under the wheat loan price situation the large irrigated farm is too large on a land acreage basis. An additional animal unit month of native pasture would only have added $0.10 to the optimum solution's net return figure and the marginal value product imputed to irrigated land was $9.41. There was an excess of 180 acres of government program allotment and 254 acres of wheat allotment. As was mentioned previously in this section of the analysis, there can be grain sorghum substituted on wheat allotment land even though the government program allotment is not limiting. This was the case under the wheat loan price situation. It can be seen from column 1 of table 12 that amount of wheat allotment not used is larger than the amount of government allotment not used. Since the government allotment constraint is the total of the wheat allotment and the feed grain allotment, the difference between the two must be equal to the amount of feed grains that were planted over and above the feed grain allotment which was 74 acres in this case. This figure was determined manually but would have been shown in the final answer if a constraint on feed grain allotment had been used in the model.

Labor was limiting in the May, June and October labor periods at the wheat loan price situation. The marginal value product of an additional hour of labor for these three labor shortage periods was $2.03, $29.02, and $1.20, respectively. It would seem that perhaps this labor shortage factor had direct bearing on the 162 acres of idle crop land. Evidently it was more profitable to apply the labor which was in short supply to other uses, mainly the livestock enterprises, than to use it in farming the crop land for the wheat loan price situation.

Both the sow and litter enterpriees have quite high marginal value producte imputed to them. An additional two litters of hogs raised under the sow and litter enterprise I was worth $332.69, and for the eow and litter enterprise II the marginal value product was $347.22 for an additional two litters of pigs. The grain eorghum fallow constraint has a marginal value product of $11.27 imputed to it. There were 46 animal unit months of wheat pasture that were not used for grazing beef cattle. Although one-half of the feed grain production could have been fed through the livestock enterprises, 11,502 bushele of this half were sold at $1.10/bushel. The amount of August water available was limitational to the farm organization of the large irrigated farm with hogs under the wheat loan price situation. An extra acre-inch of water would have added $1.90 for the net returns.

Ae has been the case for every optimal farm organization diecussed so far in this section of the paper, calves were purchased but no feeder steers were bought under the futures price situation for large irrigated farms with hogs which is shown in column 2 of table 12. One hundred and forty-nine calvee were purchased. Under the futures price situation 156 acres of crop land were idle which was eomewhat less than under the wheat loan price eituation. An additional animal unit month of pasture land would have added $0.70 to net returns while the marginal value product of irrigated land was $16.83. Both of theee figures are about the same as the corresponding marginal value product figures at the wheat loan price situation. There were 184 acres of government program allotment not planted to feed graine or wheat in this price eituation or idle, while 164 acres of the wheat allotment were not planted to wheat

or idle. Under this price situation shown in column 2, feed grains were not substituted on wheat allotment acres which is evidenced by the fact that the amount of government program acres not planted to wheat or feed grains was larger than the amount of wheat allotment acres not planted to wheat. This difference of 20 acres would indicate that 20 acres of the feed grain allotment was not used for feed grain production but was either idle or used to produce some crops other than wheat or grain sorghums.

As under the wheat loan price situation, labor is again a limiting factor on the optimal farm organization under the futures price situation. June and October labor supplies were completely used up. The marginal value product of an additional hour of June labor was $46.02 while for October labor it was $5.31. May labor was not limiting under the futures price situation as it was at the wheat loan price situation.

The "shadow" price of an extra litter of hogs for the sow and litter I enterprise was $155.73 while for the sow and litter II enterprise it was $175.54. These two figures were lower under this price situation than the same two figures were under the wheat loan price situation. This is partially explained by the lower hog price under the futures price situation of $20.83/hundredweight as compared to the price of $24.50/hundredweight for hogs in the wheat loan price situation. The marginal value product of an additional acre of grain sorghum on fallow was $10.68. There were 36 animal unit months of available wheat pasture land not used for grazing purposes. Of the potential livestock feed 7,774 bushels were sold at $1.20/bushel. The "shadow" price on the August water limitation was $1.16 for an additional acre-inch of water.

Since as was mentioned in the discussion of table 11, there was no beef produced under the current price situation, so we see that in column 3 of table 12 no beef animals were purchased under the current price situation. In the optimal farm organization of the large irrigated farm with no hogs at this price situation, 28 acres of crop land were not used for crop production but were unused. Also, none of the 385 animal unit months of available native pasture land were used as result of no beef production. The only category of land that was limiting to the optimal farm organization was irrigated land which had a marginal value product of $19.22. Again, as in the other two price situations, the government program allotment and the wheat allotment was not all used up. As was explained previously, when the amount of government program allotment in excess is larger than the wheat allotment in excess there is no substitution of feed grains on wheat allotment. By the nature of the model no wheat can be substituted on feed grain allotment acres. One hundred and four acres of the excess government program allotment was excess wheat allotment, while the other 10 acres was excess feed grain allotment.

Only June labor was limiting under the current price situation for the large irrigated farm class with hogs. It had a "shadow" price of $46.07. The "shadow" price for an additional two litters of hogs under the sow and litter enterprises I and II was $318.64 and $335.14, respectively. The amount an additional acre of grain sorghum on fallow would add to net returns was $8.02. There were 237 animal unit months of wheat pasture not used for beef production. Of the potential livestock feed available 10,583 bushels were sold for cash. An additional

acre-inch of irrigation water in August would have added very little to net returns.

If we take the amounte of wheat allotment that were not used for wheat production from table 12 for each price eituation and subtract them from the total amount of wheat allotment available for the large irrigated farm class, we will get the amount of the wheat allotment used for wheat production. For the wheat loan price situation 469 acres of wheat allotment were used for wheat production. For the futures price situation 559 acres were used and under the current price situation 619 acres were ueed. When it ie considered that 567 acres were allowed for wheat allotment before the increase was allowed, it can be eeen that in the wheat loan price situation and the futuree price eituation not all of the wheat allotment would be used for wheat production even if there had been no increase in the wheat allotment.

Comparison

The comparieone made in this section will be concerned with comparing some of the differences in the optimal farm organizations between the large irrigated farm without hoge and the large irrigated farm with hogs at the three price eituatione that have been discussed in two farm situations.

If again we oompare the net return figuree for the without hogs and with hoge eituations ae we did in the case of the small irrigated farm olaes, the price eituations programmed with hogs allowed in the optimal solutione in each case had a higher net return figure than did the corresponding net return figure without hogs allowed in the optimal

solution. The wheat loan price situations in both tables 9 and 11 are similar in some respects, perhaps more so than either the two futures price situations or the two current price situations in these two tables. Beef production decreased very little when hogs were allowed in the wheat loan price situation for the large irrigated farm as compared to the beef production in column 1 of table 9 for the same farm class without hogs at the wheat loan price situation. Beef production seemed to be able to compete better with pork production under the wheat loan price situation than under the other two price situations.

It will also be noticed that the addition of hogs to the solution decreased wheat production in every price situation. This can be seen by comparing the wheat production amounts in tables 9 and 11 for each price situation. But this decrease in wheat production did not seem to bring about an increase in grain sorghum production at every price situation. In fact, only at the current price level was there an increase in grain sorghum production when hogs were allowed to come into the solution and wheat production declined. It is also interesting to note that only under the wheat loan price situation, which assumes a low wheat price, did either wheat or feed grains exceed their allotment constraints. For large irrigated farms with and without hogs the acreage of feed grains produced exceeded the feed grain allotment constraint in both situations. Wheat allotment was not limiting under any of the price situations. No irrigated corn was produced at any of the price situations for the large irrigated farm class either with or without hogs.

As would be expected, more livestock feed was fed when hogs were allowed in the optimal solutions under each price situation than when no

hogs were allowed in the optimal solution for large irrigated farms. Also with hogs in the solutions there was excess crop land under each price situation, while when no hogs were allowed in the solutions all the crop land was used. It was felt that because of the limited supply of labor available when the labor intensive hog enterprises were allowed to come into the solutions, the shortage of labor became so critical that part of the crop land could not be farmed. It was more profitable to use the labor for hog production than for crop production.

CHAPTER V

SUMMARY AND CONCLUSIONS

Four types of farms were programmed, using linear programming as the tool of analysis, at three levels of product prices. We were mainly concerned with seeing what adjustments should be made on irrigated farms in southwest Kansas in light of the recent announcement by the U. S. Department of Agriculture of an increase in wheat allotment acres. Along with this the hog enterprise was also allowed to come into the optimal solutions in order that it could be seen how it would affect the optimal organization on these same irrigated farms. There were two irrigated farm classes programmed. One class consisted of irrigated farms less than 1,000 acres and the second class was made up of irrigated farms greater than 1,000 acres.

In our dynamic agricultural economy, a combination of enterprises should not become fixed so as to rule out consideration of alternative farm plans as technology and price expectations on which production plans are based appear to favor a change in the enterprise combination. Each farm operator must consider his individual situation with respect to land, labor and capital available and his own evaluation of future price prospects.

When beef was produced, (it was under every price programmed for both farm classes except one) it was a general result that calves were always purchased rather than raised through a cow herd and no feeder

steers were purchased. When steers were fed out in dry lot, these steers were obtained by transferring calvee from the calf enterprieee to the fed steer enterprises. The bringing in of the hog enterprise, in general, caused beef production to decrease on both the small and large irrigated farm classee.

Hoge appear to be an enterprise of considerable potential in this southwestern Kansas area. Hogs were limited to 60 littere per year and the full amount were produced under all price situations for both large and small irrigated farms when hogs were allowed to come into the optimal solutions. In some additional programming, (the results are not shown or discussed in this paper) when no limits were placed on the number of hogs that could be raised, ae many as 84 litters were produced by the small irrigated farm class and as many as 156 littere by the large irrigated farm class. The additional programming done in connection with this study concerning the hog enterprise indicated that hogs were still quite competitive even for pork prices in the $15 to $17 price range. Thus assuming that producers with managerial ability in hog production are present, hogs could be a very profitable endeavor on irrigated farme in southwestern Kansas.

For the small irrigated farms our analysie indicated that it would be most profitable to plant most of the increased amount of wheat allotment to wheat, although in several of the price situations not all of the additional allotment was used. Grain sorghums tended to occupy land not planted to wheat. In the futures price eituation and the current price eituation there was quite a large "shadow" price for wheat allotment. Under each price situation for the small farm class (with and

without hogs) either the government program allotment, the wheat allotment or both were limiting.

The large farms do not use much of the increased wheat allotment. In fact, for the two wheat loan price situations, (with and without hogs) not even all of the old wheat allotment was planted to wheat. Similarily, for the futures price situation (with hogs), when the wheat abandonment factor was taken into account, not all of the wheat allotment increase was used up.

This seemed to have been caused by the fact that in the wheat loan price situation and futures price situation, on the large farms, both with and without hogs, that the labor intensive livestock enterprises tended to come into the solution and the wheat enterprise could not compete for the labor that was needed.

The allowed increase in wheat allotment was used only to a limited extent on the large farms, while it was almost completely used on the small farms. This would seem to indicate, (1) that the small farmer should benefit relatively more from the wheat allotment increase than the large farmer; (2) one could expect that most of any increase in wheat production resulting from the new increase in the wheat allotment, economically speaking, should come from the small irrigated[1] farms.

The optimal solutions for small farm classes suggest a moderate increase in beef cattle raised at the wheat loan price and futures price situations considered with no hogs in the program. But with hogs in the

---

[1]This is a statement of limited scope as we are considering only two farm situations here. The statement may not neceesarily apply to farms with dry land only or similar farms in other areas.

program it would seem that present produotion of beef cattle would be best. The results obtained with hogs in the program would definitely indicate that this enterprise ehould be considered in a much more intensive way than the current organization on small farms would indicate. It would seem that a large adjustment, perhaps even larger than indicated in the optimal solutions, should be made in pork production. Such adjustments would require managerial ability comparable to what was assumed in our data, however.

Corn was not produced on the small irrigated farms when hogs were not included, rather irrigated land was allocated to grain sorghums and wheat. The optimal solution showed corn being raised when hogs were present, in the futures price situation, but in none of the other solutions was any corn produced. The analysis would also indicate a shift from raising alfalfa to raising forage sorghum for the roughage needed on the small farms.

The optimal solution for the large farms also showed that the number of beef cattle raised, when no hogs were in the program, should be increased slightly from the current number raised for the wheat loan price and futures price situations. The number of beef cattle raised when hogs were in the solution, for the same two price situations, were about the eame as those presently being raised. But for the current prioe situation the number of cattle raised, with no hogs in the solution, should be about one-half of those currently raised, and with hogs in the solution, no cattle should be raised.

The reeults of this study for the large farm classes also suggest that more grain sorghums should be produced than is presently being

produced. The optimal eolutions indicated a no production of corn for both the with hog and without hogs cases on the large farms, while current organizations showed 36 acres of corn were being raised. Again, forage eorghum would replace alfalfa in the current organization.

As with the small farms, the hog enterpriee for the large farms should be carefully considered. At all price situations the hog enterprise increased net farm income considerably. The results of this study would suggest a potential for an adjustment to increase pork production considerably over current hog output.

It seemed to the author that there was almoet no end to the programming that could be done with the model presented in this paper. It would be useful to consider more price combinations than juet the three used in this etudy. Perhape it would be of interest to set up capital limits to limit the amount of capital available to the farm firm instead of assuming capital to be available in unlimited amounts as was aesumed in this study. One could aleo allow, by the method of parametric programming, the three land category restrictions to vary and to see how this would affect the wheat and hog enterpriees, especially on these two irrigated farm classes. These are just a few of the variations to which this problem could be subjected.

In some cases it was felt that further analysie would not be very worthwhile. For example, it does not seem that any further analysis of the beef production would tell us very much about the factors affecting beef production. This ie due to the fact that in this particular problem the amount of pasture land limits beef production on the two farm classes considered. Therefore, even though different things euch ae prices were

changed, beef numbers could not go past certain limite except as pasture land was allowed to increase.

In general, there are many variations of the probleme studied in this paper that could be profitably considered. There are many aspects other than the wheat and hog problems considered in thie etudy that also oould be studied.

The full extent and magnitude of the adjuetmente indicated by this study are unlikely to occur within the next few yeare. But the direction of adjustment in resource use suggested by this analyeis merits eerious consideration by farmers in this study area.

APPENDIX

APPENDIX A

Labor Requirements, Expected Production and Cost Coefficients for the Crop and Livestock Enterprises Considered in This Study

Enterprise	Unit	Dry land crops			
		Wheat continuous	Wheat on fallow	Barley on fallow	Gr. sorghum on fallow
Labor:					
January	hr/ac	0	0	0	0
February	"	0	0	0	0
March	"	0	0	0	0
April	"	0	.20	.20	.40
May	"	.03	.20	.20	.61
June	"	.38	.59	.59	.28
July	"	.20	.20	.20	.17
August	"	.17	.17	.17	.17
September	"	.38	.39	.39	.17
October	"	0	0	0	.25
November	"	0	0	0	.25
December	"	0	0	0	0
Total labor:	"	1.16	1.75	1.75	2.30
Production:					
Wheat yield[b]	bu/ac	10.0	17.4	17.0	0
Grain sorghum or corn yield[b]	"	0	0	.23	37.0
Wheat pasture	A.U.M.	.17	.23	0	0
Aftermath	A.U.M.	0	0	0	.2
Silage or forage	ton	0	0	0	0
Per cent harvested	%	67	76	63	90
Beef	cwt	0	0	0	0
Pork	cwt	0	0	0	0
Costs:					
Preharvest	$	1.74	2.39	1.99	3.27
Harvest	$	.64	.77	.66	1.27
Allocable fixed	$	3.33	4.52	4.25	5.86
Total costs:[c]	$	5.59	7.68	6.90	10.40
Livestock costs:					
Investment	$	0	0	0	0
Variable costs	$	0	0	0	0

APPENDIX A (continued)

Enterprise	Unit	Dry land crops			
		Grain sorghum after wheat	Grain sorghum con-tinuous	Grain sorghum on abandoned wheat after fallow	Grain sorghum on abandoned wheat after wheat
Labor:					
January	hr/ac	0	0	0	0
February	"	0	0	0	0
March	"	0	0	.20	.20
April	"	.20	.20	0	0
May	"	.61	.61	.61	.61
June	"	.28	.28	.17	.28
July	"	.19	0	0	0
August	"	0	0	0	0
September	"	0	0	0	0
October	"	.24	.22	.24	.21
November	"	.24	.22	.24	.21
December	"	0	0	0	0
Total labor:	"	1.76	1.53	1.46	1.51
Production:					
Wheat yield[b]	Bu/ac	0	0	0	0
Grain sorghum or corn yield[b]	"	20.5	18.0	22.0	16.0
Wheat pasture	A.U.M.	0	0	0	0
Aftermath	A.U.M.	.15	.15	.15	.2
Silage or forage	ton	0	0	0	0
Per cent harvested	%	75	80	85	75
Beef	cwt	0	0	0	0
Pork	cwt	0	0	0	0
Costs:					
Preharvest	$	4.02	3.62	3.76	3.62
Harvest	$	1.01	.91	1.02	.86
Allocable fixed	$	4.87	4.45	4.24	4.38
Total costs:[c]	$	9.90	8.98	8.98	8.86
Livestock costs:					
Investment	$	0	0	0	0
Variable costs	$	0	0	0	0

APPENDIX A (continued)

Enterprise	Unit	Dry land crops			
		Sorghum silage	Forage sorghum	Wheat grain sorghum fallow	Wheat - wheat - fallow
Labor:					
January	hr/ac	0	0	0	0
February	"	0	0	0	0
March	"	0	0	0	0
April	"	.20	.20	.40	.20
May	"	.61	.61	.81	.23
June	"	.27	.16	.87	.97
July	"	.17	0	.39	.40
August	"	0	0	.17	.34
September	"	2.05	2.57	.39	.77
October	"	1.10	2.00	.24	0
November	"	0	0	.24	0
December	"	0	0	0	0
Total labor:	"	4.40	5.54	3.51	2.91
Production:					
Wheat yield[b]	bu/ac	0	0	17.4	27.9
Grain sorghum or corn yield[b]	"	0	0	20.5	0
Wheat pasture	A.U.M.	0	0	.23	.57
Aftermath	A.U.M.	0	0	.15	0
Silage or forage	ton	5.0	2.0	0	0
Per cent harvested	%	95	95	81	72
Beef	cwt	0	0	0	0
Pork	cwt	0	0	0	0
Costs:					
Preharvest	$	3.64	2.85	6.41	4.13
Harvest	$	2.00	1.64	1.78	1.41
Allocable fixed	$	6.57	5.03	9.39	7.85
Total costs:[c]	$	12.23	9.52	17.58	13.27
Livestock costs:					
Investment	$	0	0	0	0
Variable costs	$	0	0	0	0

APPENDIX A (continued)

Enterprise	Unit	Irrigated crops			
		Sorghum silage 3 irrigations	Corn irrigated	Corn silage irrigated	Alfalfa irrigated
Labor:					
January	hr/ac	0	0	0	0
February	"	0	0	0	0
March	"	.43	.43	.43	0
April	"	.77	.77	1.17	0
May	"	.52	.61	.82	.25
June	"	.37	1.02	.48	3.00
July	"	.48	.30	.42	3.21
August	"	.60	.30	.30	3.04
September	"	2.60	.20	3.53	2.91
October	"	2.60	1.51	1.77	0
November	"	.47	.30	0	0
December	"	0	.47	0	0
Total labor:	"	8.84	5.91	8.92	12.41
Production:					
Wheat yield[b]	bu/ac	0	0	0	0
Grain sorghum or corn yield[b]	bu/ac	0	85	0	0
Wheat pasture	A.U.M.	0	0	0	0
Aftermath	A.U.M.	0	.45	0	0
Silage or forage	ton	18.0	0	20.0	5.0
Per cent harvested	%	98	98	98	100
Beef	cwt	0	0	0	0
Pork	cwt	0	0	0	0
Costs:					
Preharvest	$	18.80	20.34	22.06	8.29
Harvest	$	4.85	7.84	5.32	9.00
Allocable fixed	$	22.59	17.50	28.78	22.67
Total costs:[c]	$	46.24	48.18	56.60	39.96
Livestock costs:					
Investment	$	0	0	0	0
Variable costs	$	0	0	0	0

APPENDIX A (continued)

Enterprise	Unit	Irrigated crops			
		Wheat 1 irrigation	Wheat 2 irrigations	Gr. sorghum 1 irrigation	Gr. sorghum 3 irrigations
Labor:					
January	hr/ac	0	0	0	0
February	"	0	0	0	0
March	"	0	0	.43	.43
April	"	0	0	.77	.77
May	"	0	.30	.52	.52
June	"	.84	.84	.37	.37
July	"	1.02	1.01	.48	.48
August	"	.71	.71	0	.60
September	"	.38	.38	.11	.11
October	"	.30	.30	.52	.52
November	"	0	0	.42	.42
December	"	0	0	.47	.47
Total labor:	"	3.24	3.54	4.09	4.69
Production:					
Wheat yield[b]	bu/ac	36.3	39.3	0	0
Gr. sorghum or corn yield[b]	"	0	0	69.0	88.0
Wheat pasture	A.U.M.	.52	.52	0	0
Aftermath	A.U.M.	0	0	.37	.45
Silage or forage	ton	0	0	0	0
Per cent harvested	%	96	96	98	98
Beef	cwt	0	0	0	0
Pork	cwt	0	0	0	0
Costs:					
Preharvest	$	8.71	10.13	13.35	18.37
Harvest	$	1.00	1.03	2.15	2.57
Allocable fixed	$	10.30	12.23	11.91	16.91
Total costs:[c]	$	20.01	23.39	27.41	37.85
Livestock costs:					
Investment	$	0	0	0	0
Variable costs	$	0	0	0	0

APPENDIX A (concluded)

Enterprise	Unit	Livestock activities				
		Beef cows[a] wintered & grazed	Calves[a] wintered & grazed	Calves[a] wintered	Steers[a] feeding dry lot	Sow and[a] 2 litters
Labor:						
January	hr/ac	1.95	1.16	.98	1.20	1.85
February	"	2.48	1.15	.97	1.20	3.12
March	"	2.47	1.05	.78	1.40	7.28
April	"	1.65	.96	.98	0	3.47
May	"	1.05	.40	0	0	3.93
June	"	.45	.40	0	0	1.85
July	"	.45	.40	0	0	1.85
August	"	.45	.40	0	0	2.08
September	"	.45	.40	0	0	4.86
October	"	.90	1.57	.98	1.45	2.08
November	"	1.05	.96	.84	1.35	2.55
December	"	1.65	1.15	.97	1.20	2.08
Total labor:	"	15.0	10.0	6.50	7.80	37.0
Production:						
Wheat yield[b]	bu/ac	0	0	0	0	0
Grain sorghum or corn yield[b]	"	0	0	0	0	0
Wheat pasture	A.U.M.	0	0	0	0	0
Aftermath	A.U.M.	0	0	0	0	0
Silage or forage	ton	0	0	0	0	0
Per cent harvested	%	0	0	0	0	0
Beef	cwt	4.30	3.01	2.07	4.07	0
Pork	cwt	0	0	0	0	35.32
Costs:						
Preharvest	$	0	0	0	0	
Harvest	$	0	0	0	0	
Allocable fixed	$	13.15	8.56	6.10	13.20	36.91
Total costs:[c]	$	59.17	37.32	27.83	53.31	190.42
Livestock costs:						
Investment	$	235.38	135.80	133.01	197.63	183.21
Variable costs	$	46.02	28.76	21.73	40.11	153.51

[a]Beef cows wintered on forage sorghum and grazed on native pasture. The other three beef cow enterprises have same labor requirements and cost & production figures as this enterprise shows. There are only very slight variations. This is true for wintered and grazed calves, wintered calves and feeding steers enterprises.

[b]The yield figure shown is total yield less the amount needed for seed.

[c]Total cost figure shown is net of interest charges on preharvest costs (operating capital).

APPENDIX B

HOW PRICE LEVELS WERE OBTAINED

The current price level was obtained from the Kansas Crop and Livestock Statistical Reporting Service publication "Agricultural Prices." These prices were those received by farmers in southwestern Kansas as of August 15, 1966.

The futures prices were figured on the basis of the Chicago future market for each commodity. The futures market prices are an average of the July 1967 prices for the week September 5-11, 1966, with each price lowered by the approximate transportation costs between Chicago and southwest Kansas. The transportation costs deducted for each commodity were $0.19/bushel for wheat, $0.17/bushel for feed grain, $0.75/hundredweight for beef cattle and $0.25/hundredweight for hogs.

Under the wheat loan price situation, all prices except that for wheat were assumed to be at the current price level. Wheat was assumed to be at the government loan price level of $1.17/bushel. The loan price used for wheat was an average of the 1966 loan price of wheat for the fifteen county area included in this study.

The wheat loan price was the lowest price used because it was thought that this would be the worst price that the wheat farmer could expect under any situation. He was assured this much per bushel by the government, assuming he complied with the government program. Since it was assumed that the wheat farmer would comply with the government program, he would receive a domestic certificate which would pay him

a certain amount per bushel on 35 per cent of his normal yield for the wheat he planted. He would receive this amount no matter what happened to the wheat crop as long as he planted the wheat. The domestic price per bushel assumed here was $1.32 which was the price paid under the 1966 wheat program for domestic certificates. No information was available as to what it would be for the 1967 wheat program at the time of this writing.

APPENDIX C

DEFINITION OF CASH COSTS, OPERATING CAPITAL, AND OBJECTIVE VALUES FOR CROP AND LIVESTOCK ENTERPRISES

1. Cash costs on crops were equal to the sum of the total preharvest costs and total harvest costs. For livestock the cash costs were equal to the total variable costs less interest on the operating capital.

2. Operating capital for crops was equal to total preharvest costs times the fraction of the year the capital was invested in the crops, while operating capital for livestock was equal to the total capital invested times the fraction of the year it was used for livestock.

3. The objective value in the case of crops was equal to total costs on crops. The objective value for livestock enterprises was equal to variable costs plus allocated fixed costs.

BIBLIOGRAPHY

Public Documents

U. S. Department of Commerce. United States Census of Agriculture: 1945, Kansas. Vol. I, part 13. United Statee Government Printing Office, Washington, 1946.

U. S. Department of Commerce. United States Census of Agriculture: 1950, Kansas. Vol. I, part 13. United States Government Printing Office, Washington, 1952.

U. S. Department of Commerce. United States Census of Agriculture: 1954, Kansas. Vol. I, part 13. United States Government Printing Office, Washington, 1956.

U. S. Department of Commerce. United States Census of Agriculture: 1961, Kansas. Vol. I, part 21. United States Government Printing Office, Washington, 1961.

Books

Dorfman, Robert, Samuelson, Paul A., and Solow, Robert M. Linear Programming and Economic Analysis. New York: McGraw-Hill Book Company, Inc., 1958.

Fergonson, Robert O., and Sargent, Lareun F. Linear Programming: Fundamentals and Applications. New York: McGraw-Hill Book Company, Inc., 1958.

Heady, Earl O. Economics of Agricultural Production and Resource Use. New York: Prentice-Hall, Inc., 1952.

Heady, Earl O., and Candler, Wilfred. Linear Programming Methods. Ames: Iowa State University Press, 1958.

Journals

Puterbaugh, Horace L., Kehrberg, Earl W., and Dunbar, John O. "Analyzing the Solution Lableau of a Simplex Linear Programming Problem in Farm Organization." Journal of Farm Economics, Vol. 39, No. 2 (May, 1957), pp. 470-479.

Bulletins

Bark, L. Dean. Chances for Precipitation in Kansas. Agric. Exp. Sta. Tech. Bull, 461, Kansas State University of Agriculture and Applied Science, May, 1963.

Bidwell, O. W. Major Soils in Kansas. Agric. Exp. Sta. Cir. 336, Kansas State University, July 1956.

Castle, Emery N. Adapting Western Kansas Farms to Uncertain Prices and Yields. Agric. Exp. Sta. Tech. Bull. 75, Kansas State College, 1954.

Erhart, Andrew B., Meyer, Walter R., and Grover, Ben L. Irrigation in Western Kansas. Kansas Agric. Exp. Sta. Cir. 324, Kansas State University, May 1958.

Extension Service. Farm Management Summary and Analysis Report. Kansas State University, 1964.

Extension Service. Farm Management Summary and Analysis Report. Kansas State University, 1965.

Kansas Crop and Livestock Reporting Service. Planting, Development, and Harvest of Major Kansas Crops. Topeka, Kansas, February, 1963.

Kelley, Paul L., McCoy, John H., and Manuel, Milton L. The Competitive Position of Kansas in Marketing Hogs. Agric. Exp. Sta. Tech. Bull. 118, Kansas State University, October, 1961.

_____. Mitchell County Irrigation Demonstration Farm. Annual Report, Kansas State University, 1964.

Nohre, C. O., and Jensen, H. R. Profitable Farm Adjustments in South-Central Minnesota. Agric. Exp. Sta. Bull. 471, University of Minnesota, May, 1964.

Skold, M. D., and Epp, A. W., Optimal Farm Organizations For Irrigated Farms in South-Central Nebraska. Agric. Exp. Sta. Res. Bull. 222, University of Nebraska, February, 1966.

Theses and Dissertations

Lin, G. "Organizations of Farms in Western Kansas: A Statistical and Programming Approach," Unpublished Ph. D. Dissertation, Kansas State University, 1964.

A STUDY OF IRRIGATED FARM ORGANIZATION ADJUSTMENTS IN SOUTHWEST KANSAS

by

DALE JOHN BLOMQUIST

B. S., Iowa State University, 1965

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Economics

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1967

In light of the recent announcement by the U. S. Department of Agriculture of two 15 per cent increases in the wheat allotment acreage for wheat farmers, an attempt was made in this study to determine how farmers with irrigated land in southwest Kansas should adjust their farm business in light of this development so as to obtain maximum net income returns to land, operator labor and management. The potential for increased pork production in relation to these same irrigated farms was also etudied and analyzed. This study was a part of a larger regional wheat aggregation project being conducted at Kansas State University. Linear Programming was used as a tool of analysis in this study.

A three hundred and ten farm sample was taken from the fifteen county study area in southwest Kansas. This information was obtained from the 1964 farm assessor's books of this area. The countiee included in this study were Finney, Grant, Gray, Greeley, Hamilton, Haskell, Kearny, Lane, Meade, Morton, Scott, Seward, Stanton, Stevens and Wichita. The farme in the sample that had irrigated land were then divided into two size categories on the basis of total acres. These two size categories were (1) irrigated farms with greater than 1,000 total acres and (2) irrigated farms with lees than 1,000 total acres.

The two irrigated farm classes were each programmed using three alternative sets of price expectations. For each set of price expectations the farm class was programmed with and without hog enterprise.

Linear Programming analysis of the smaller irrigated farm class revealed that this farm business should adjust its organization to use most or all of the increase in wheat allotment allowed depending on the price expectations used. This result was true in general with and

without the hog enterprise. Allowing hog production on the small irrigated farm showed this enterprise to be quite profitable. In general, net returns to land, operator labor and management were considerably higher at the three price expectation levels with hogs than without the hog enterprise. Beef production and wheat production decreased in general when pork production was allowed.

For the large irrigated farm class, the analysis showed that overall these farm businesses should not adjust their present organization to take advantage of the increased wheat allotment acreage for wheat production. But there was considerable substitution of grain sorghums on wheat allotment acreages. Both of the above results were usually found with and without hogs. Labor was a limiting factor both with and without hogs in the program for the large irrigated farms. As was the case for the smaller irrigated farms, hogs were a very profitable enterprise for the large irrigated farm class. June labor appeared to be the most limiting labor period.